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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*).

Forthcoming Event.

Institute of British Foundrymen.
JUNE 7-10.
Institute of British Foundrymen:—Twenty-ninth Annual Conference at Newcastle-on-Tyne.

How Long?

The Annual Report for the Institute of British Foundrymen recently circulated gives an encouraging account of the number of schools which have, for the first time, furnished courses for foundry students during the past winter, leading to craft and national certificates. The account given in this issue of the provision now being made for foundry education at Aachen prompts the query as to how long this country is to await such a school. The foundations have been firmly laid in the craft and national certificate courses referred to above, but there is no doubt that something further is required for those men who ultimately will be called upon to take charge of large foundry organisations. From this point of view it is unnecessary to argue whether employers should encourage students to attend such a school or whether students should take a chance on a future opening out before them. For neither can happen unless the facilities are provided. At the present time specialised training of the kind we have in mind is not provided by any of the universities having a faculty or department of metallurgy, and we doubt if it ever could be so provided. At any rate, not more than one such school is required for the country as a whole.

At such a school students could learn to use and to appreciate British foundry plant and equipment. Without it foundry science is becoming much too complicated and much too involved to be studied as a part-time proposition, with the result that our position in world-founding is being undermined and the leadership conferred on us by priority in the art and by abundant suitable raw materials is challenged. Has the industry the courage and the foresight and the requisite degree for unity for purpose to bring about such a state of things? Only by taking the initiative can the industry take that preponderating share in control which will enable it to be sure of specifying the type of curriculum and courses required. To allow it to be developed entirely by the teaching and professional sides would mean an overemphasis on the purely metallurgical side, which is the chief reason why the ordinary metallurgical school cannot serve the purpose required. It is required to teach principles, but not merely the principles of metallurgy. It must also teach the principles of founding.

Now—and Then.

We have been looking over some of the earlier Proceedings of the British Foundrymen's Association and comparing the type of Paper then presented with those currently included. The difference is both striking and significant. In the early days most of the metallurgical Papers were of a tutorial nature, given by experts versed in the science of pure iron-carbon alloys. This has been substituted in recent years by the presentation of data evolved by foundry metallurgists for use of foundry executives. The most striking change, however, has been in connection with the practical Papers. The earlier efforts provided a means of exchanging technicalities, classifiable as tricks of the trade. Now there is noticeable a distinct tendency towards the presentation of readily utilisable data. Thus, when a practical executive is describing a phase of manufacturing a casting, he gives full information as to the composition of the metal used and its casting temperature, in contrast with mixtures, and nebulous phrases such as "good hot" or "medium." An improvement has been noted in reference to sands, wherein percentages are used instead of barrows and buckets as a means of measurement. There is, however, still room for improvement in these cases. One of the most striking changes is the demand by the practical man for physical data of the various grades of cast iron. We distinctly remember that a short time after the formation of the British Cast Iron Research Association many foundry owners were demanding research of a practical character, as they were unable to appreciate the utility of theoretical investigations. This change is shown by the fact that amongst the earliest endeavours of the Grey Iron Sub-Committee of the Institute of British Foundrymen was to assemble all published physical data for cast iron.

This particular change has been largely brought about by the introduction of alloy cast iron, and especially the scientific manner of its presentation, which has reacted on the non-alloyed material.

It is a matter for comment, that mechanical handling was disregarded until comparatively recently. The comparisons we have drawn are not disparaging to earlier endeavours; the tutorial work referred to was an essential step, whilst practical experience very clearly showed the exchange of "tricks of the trade" to be inadequate, as the whole of the circumstances were only partially understood by both parties, on account of the lack of definite data.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents]

Wiltshire Brass Hardware.

To the Editor of The Foundry Trade Journal.

Sir,—With reference to Mr. I. Newtown Lewis' letter in your last issue, we would state that there was in existence 200 years ago a brass and bell foundry here, of which we are successors, but we do not carry out any of the bell work now.

We are makers of various brass work and old firebacks, etc., from original copies, but we cannot say whether the existing foundry was the one which made the brass ware in question, as all records are gone and we do not know where they are likely to be traced. We would be pleased to go further into the matter if your correspondent wishes us to.—Yours, etc.,

p.p. Loveday & Company.
W. E. Stock.

Aldbourne, Marlborough, Wilts.

The Shape of the Tensile Test-Bar for Cast Iron.

To the Editor of The Foundry Trade Journal.

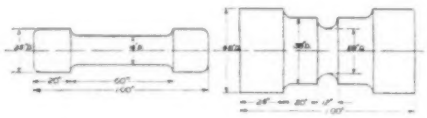
Sir,—In a Paper in your issue of January 28, 1932, the writer offered an explanation of the reduced strength of short thick tensile test-bars in terms of shear effect in the material. Permission is requested to pursue the matter further in the light of the very instructive results published in B.C.I.R.A. Bulletin No. 4, Vol. III, reproduced in your issue of May 26, 1932.

The results, it is thought, clearly indicate that in the B.S.I. standard 1.2 in. bar, when the gripped length D is 1 in. or more, there is no appreciable shear effect. Put in another way, when the ratio of grip length D to grip diameter A is 1:1.2, the shear effect is negligible. The question, it is suggested, which remains for answer by test is whether the shear effect is negligible in the case of the B.S.I. standard 2.2 in. bar. In this bar the ratio in question is 1:2.2. It is probably not necessary to test a 2.2 in. dia. bar to prove the matter. The same shear effect, if it exists in fact, may reasonably be expected in a bar of 1.2 in. dia., if the grip length is reduced to 0.54 in., *i.e.*, the ratio would be 0.54:1.2 = 1:2.2. Shear effect is essentially a question of ratios, not of actual dimensions.

An examination of the dimensions of German standard test-bars suggests that the existence of shear effect was allowed for when the dimensions were decided, because the ratio of grip length to grip diameter is kept practically constant for the whole series of eleven bars (*vide* Dr. H. W. Swift's Paper, The Foundry Trade Journal, March 17, 1932, page 174, Fig. 2). The actual ratio works out at approximately 1:0.825, or fairly close to the British standard 0.875 in. bar, and by comparison with the 1.2 in. and 2.2 in. bars very much on the safe side as regards shear effect.

Of equal interest in the B.C.I.R.A. test-results is the recorded fact that the gauge length can be reduced to zero without affecting the accuracy of measurements of ultimate tensile strength. It is thought that it will be permissible to state this experimentally-ascertained fact in another way by saying that if there is no shear or other effect at the grips, there will be none in the gauge length.

There remains the question of testing tiny specimens in tension on a machine such as that described in your issue of July 30, 1931. If the shape of the test-bar is as reproduced in the figure (*a*) the ratio of grip length to grip diameter is 1:1.25, which the B.C.I.R.A. tests indicate may be adequate. But the grip ends are of a nature to put the grip part in compression, and there may therefore be a tendency for a high skin stress where the diameter is reduced at the fillet. If this be true a reasonable remedy offers itself, namely to effect the reduction in diameter in two stages, such as are indicated in Fig. (*b*), necessitating an alteration in grips and



Figs. A (left) and B (right).

possibly of the machine. The actual dimensions giving uniform and reliable results would be determined by test, and those stated in (*b*) are intended solely as a basis for discussion. It is, however, suggested that if the machine is capable of developing a maximum pull of 2 tons, the cross-sectional area of a cast-iron test-bar should be made at least $\frac{1}{12}$ sq. in. and not $\frac{1}{10}$ sq. in. as for steel specimens.—Yours, etc.,

A. C. Vivian.

Middlesex.
May 27, 1932.

P.S.—With a view to further investigation of shear effect (if any) on large diameter bars, it would be of great interest to the writer to have a record of the actual dimensions of the grip ends of the C.I. specimens which Dr. Swift tested and reported in The Foundry Trade Journal, January 30, 1930, page 79, Fig. 1.

Soda Ash and Sulphur Removal.

To the Editor of The Foundry Trade Journal.

Sir,—One of the most important developments of recent times is the use of soda ash for desulphurising liquid cast iron, and in this connection I should be pleased to learn the name of the person to whom the credit should be given for the invention or first use of soda ash. In the metallurgy of steel, one usually knows and acknowledges the source of such developments. To take an allied discovery—that of desulphurisation of steel by calcium fluoride in the basic open hearth—herewith one naturally associates the name of Saniter. Amongst early users of soda ash were the firms of Kryn & Lahy and the Metropolitan-Vickers Company, of Trafford Park. Perhaps, to ascertain the facts, Mr. Deschamps and Mr. Jolley would state when and under what circumstances they first used soda ash.—Yours, etc.,

Historicus.

Notes from I.B.F. Branches.

London.—Members of the London Branch visited the blast-furnace plant of Stewarts & Lloyds, Limited, at Corby, Northants, on Wednesday, May 25, and were received by Mr. S. J. Lloyd. The morning was devoted to an inspection of the furnaces (one of which was being tapped at the time), the power plant and the Lodge-Cotterell gas-cleaning plant. After luncheon the ironstone mines and limestone quarries were visited.

Before leaving tea was served, and in a short speech Mr. S. J. Lloyd referred to the fact that Northants ironstone deposits were specially referred to and legislated for in the days of King John. Mr. C. H. Kain, Senior Vice-President of the Branch, in thanking the hosts for a very interesting day, asserted that if politicians had made as much progress since the time of King John as had the works being visited, the country would be as nearly as possible Utopia.

Random Shots.

The appearance of a detective story by Francis Everton should by now be regarded as an event of particular interest to those of "Marksman's" readers who delight in thrillers that really thrill. Most of you know, perhaps, that the pseudonym of "Francis Everton" masks the identity of a well-known foundryman. What most of you probably do not know is just who that foundryman is. Well, he is Mr. F. W. Stokes, B.Sc., managing director of the Sheepbridge Stokes Centrifugal Castings Company, Limited. To the best of "Markman's" knowledge, very few people within the industry have been aware of the fact; Mr. Stokes has kept his secret a close one. But truth will out . . . and with it, on this occasion, the congratulations and best wishes of everybody connected with the foundry trade.

* * *

Francis Everton's latest book, "The Young Vanish," was published a few weeks ago by Collins. It is a remarkably good yarn, every bit as exciting as the author's previous books. Those of you who have read "The Hammer of Doom" and "The Dalehouse Murder" will need no further recommendation.

* * *

"Marksman" doesn't intend to give away the whole story of "The Young Vanish," but there are several points that he would like to mention. The opening chapter tells us that "the financial crisis of 1931 loomed suddenly, and was courageously averted." And some time after, when Russia's Five-Year Plan is nearing completion, a number of prominent trade-union officials are killed, accidentally to all appearances. Detective-Inspector Allport, however, suspects the cause of these deaths, and Francis Everton makes him go to the Board of Trade for the purposes of consulting the *accident records of the Factory Inspection Department.* The author wrote this, I fancy, with a twinkle in his eye!

* * *

Involved in the story, and suspected of murder, there is a young fellow, Kisney, who is interested in "the recently-developed invention for the hardening of cast iron by the nitrogen process." He has a factory in Bermondsey, in which there are about thirty electric furnaces for hardening by this "Nitrard" process. And an amusing paragraph describes Kisney's explanation of Brinell to Allport, when the detective is busily thinking of something else:—

"As far as he (Allport) could make out, Brinell was a scientist who lived in the year 1050, at least he fancied he heard Kisney saying something about Brinell and 1050. . . ."

* * *

One of the most interesting parts of the book, "Marksman" thought, was the chapter on "A Metallurgical Finger Print." Francis Everton brings into it some of the specialised knowledge of Mr. F. W. Stokes, and Allport is treated to a metallurgical dissertation by a gentleman who is Mr. T. E. Mason, technical director of the Sheepbridge Stokes Centrifugal Castings Company, Limited. More will be said of this metallurgical finger print next week, after consulting Mr. J. E. Hurst at Newcastle.

Marksman.

XUM

The Working of Rotary Pulverised Fuel Fired Melting Furnaces.*

By W. Scott and S. E. Dawson.

PART I.—PRACTICAL CONSIDERATIONS.

By W. Scott.

Metal melting, whether for grey-iron or malleable castings, is the first and most important problem in any foundry. The measure of success obtained by this section of the works is felt in every individual casting produced. Whereas the available sand supply may not be suitable for all the castings to be made, it will always be found to effect only a portion of the castings, but in the case of the molten metal this affects, for better or worse, the entire production.

Moulding methods are steadily becoming standardised operations owing to the reliability and design of modern moulding machines, and so the only opportunity for improving the product rests with the melting department. It is with great pleasure that one is able to discuss a method of melting, which the author genuinely believes to be a definite step forward. This method is by pulverised-fuel-fired rotary melting furnaces.

This Paper is not meant to be a conclusive treatise on the subject, but a contribution to the growing demand for information. New discoveries are made daily, and the stage has now been reached where it can be emphatically stated

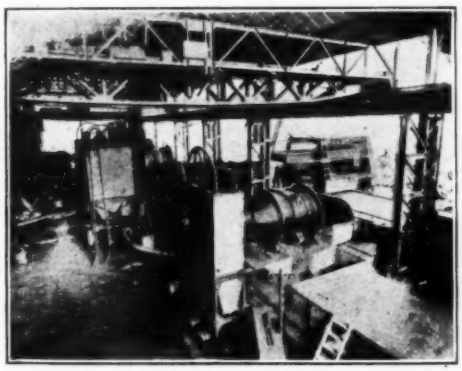


FIG. 1.—GROUP OF SESCI FURNACES INSTALLED AT THE WORKS OF MESSRS. ARMSTRONG, WHITWORTH (IRONFOUNDERS), LIMITED.

that the modern type rotary furnace has come to stay.

Objects of the Rotary Furnace.

These can be classified as follow:—(1) To eliminate the guess-work involved in operating the cupola, which is largely of an uncontrollable nature and owes its popularity entirely to the fact of its cheapness in first cost and operation, and not in any way to the quality of metal produced.

(2) To open up the field for uses of cast iron not restricted in quantity of any one of its elements. In other words, to produce an iron of any analysis. Experience to date has covered the following ranges:—T.C., 0.1 to 3.5; Si, 0.1 to 4.0; Mn, 0.1 to 1.2; P, 0.06 to 1.0; S, 0.035 to 0.15; Ni, 1.0 to 5.0; Cr, 0.5 to 18.0; and Ti, 0.1 to 2.5 per cent.

It will be readily seen that successfully to melt and pour iron containing some of the foregoing ranges of analysis requires extremely high temperature. This is perhaps the most important function of the rotary furnace. Temperatures in ordinary practice without delay have reached 1,650 deg. C. Such a temperature means fluid metal, the foundryman's joy, less waste in actual "poured out" scrap, higher strength owing to the finer graphite formation and a degasified product generally.

Design of Furnace.

The furnace body consists of a steel shell mounted on two tracks, which run on oscillating rollers. The body is lined with a rammed acid or basic lining about 14½ in. thick, and is rotated by means of a motor, gear box and chain drive. This rotation gear is also arranged so that a very slow motion is used for tapping purposes. At the combustion end of the furnace is fitted a special burner, which in this type is specially designed for the combustion of anthracite or semi-anthracite fuel. The opposite end of the furnace is connected by a movable head to the flues. The products of combustion are led first to the recuperator and then to the chimney.

The air supply is provided by a Roots-type blower which delivers a constant volume of air for a constant speed. This air is then carried through a recuperator and preheated, according to the progress of the melt, up to 600 deg. C. It then passes under the coal hoppers where it receives the coal, which in turn is measured out by positive screw feeders and then to the furnace. At the point where the pipe line joins the furnace a rotary airtight joint is fitted which prevents any loss of the carefully measured out air and coal. As the motors for the blower and coal feeders are variable-speed type, any quantity of air and fuel can be delivered at once at the will of the operator. An important point about this type of furnace is that all the air entering the furnace is directly controlled, thus permitting accurate control of flame and atmosphere.

Coal.

Two kinds of coal are used. First, a soft or bituminous coal with a volatile content of 30 or 35 per cent. This is used only in the morning when lighting up a cold furnace. After the melt has progressed until the ingoing air has reached a preheated temperature of about 220 deg. C., the main coal supply is turned on and the soft coal replaced. The anthracite type of coal contains from 4 to 12 per cent. volatile matter. The

TABLE I.—*Composition of Anthracite Coals Used with Success.*

	Moisture.	Fixed carbon	Ash.	Volatile.	S.	B.T.U.
Welsh ..	1.15	92.70	3.30	4.00	0.18	14,200
,, ..	1.23	90.60	4.20	5.20	0.38	14,700
,, ..	1.40	91.80	3.90	4.30	0.22	14,300
,, ..	2.76	90.3	3.80	5.90	0.23	14,800
Scotch ..	8.60	80.54	6.60	12.86	0.28	14,700
,, ..	9.14	84.57	2.43	13.00	0.19	15,300

best results have been obtained by us from coal with up to 10 per cent. volatile. The moisture content of the coal is best kept below 2 per cent. for the efficient working of any pulveriser. The pulveriser should give consistent results and a finished product that will pass 85 per cent. through a 200 mesh per in. seive. Any decrease below 75 per cent. will immediately transfer carbon to the charge and make the resulting analysis in error. The ash content of the coal is immaterial to the final results except that a corresponding increase in coal consumption will be apparent owing to the loss in calorific value. Coal is usually used containing from 5 to 8 per cent. ash. The coal being used costs 6s. to 8s. at pithead.

Table I shows analyses of typical coals which have been used satisfactorily.

Raw Materials.

This is one of the greatest benefits conferred by the rotary furnace to the foundry industry—its adaptability to melt and convert to the correct analysis almost any raw ferrous materials. Cast-iron scrap of any shape and size up to the size that will pass the charging door and down to borings can be easily melted without any special arrangement. Steel also presents no difficulty, and up to 100 per cent. has been melted and poured as such. With the aid of two such materials and a supply of ferro-silicon, ferro-manganese and ferro-phosphorus any particular analysis is simply a question of schoolboy arithmetic.

Melting Times.

It will be obvious, from the description given earlier of the furnace, that the first melt must take longer than subsequent melts on account of the time required to heat up the thick lining and flues. As the heating of the metal is done principally by means of the rotation—when the hot roof is turned under the bath it naturally follows that a cold lining means longer period for melting. A first heat generally takes, in round figures, 3 hrs., and a second about two. Third and fourth improve slightly, and can usually be completed in 1 hr. 50 min. These times are based on a fully-charged furnace with a final tapping temperature about 1,500 deg. C. The greatest difficulty at the moment is to tap out soon enough. If metal is given to the foundry, as it has been lately, at 1,600 deg. C., too much time is wasted in standing over the ladle waiting for a suitable pouring temperature. This, of course, applies chiefly to fairly large castings where a risk of a "run out" is too great at above 1,320 deg. C. It is quite common

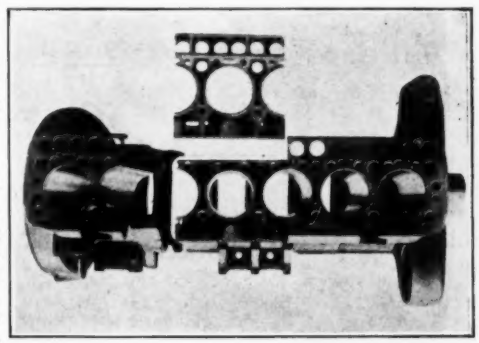


FIG. 2.—AUTOMOBILE-CYLINDER BLOCK.

to stand a ladle for 45 min. before pouring even cylinder-work, which is normally cast hotter than general work.

Allowing for charging and tapping, it is possible to obtain four heats daily from one furnace in a normal working day. In these days of economic stress it appears a sin to shut down the furnace at all, because of the waste of heat units contained in the lining and flues. This means an extra hour for the first heat on the morrow. One feels also that a continuous system would assist the lining to give of its best instead of a daily heating and cooling, which is always bad treatment for refractories.

Experience with five new linings to date points to the fact that about 140 melts can be expected without any patching of the main body of material. Experiments are now being tried in patching which it is hoped will enable a life of 200 to be obtained.

A Battery of Four Furnaces and Personnel Required.

The group of furnaces shown in Fig. 1 has been installed to give a daily output of molten iron of 78 tons. By starting the furnace 2 hrs. before the foundry this can be increased to 100 tons per day when the "good old days of plenty" return. Two main points of interest

* A Paper presented to the London and Lancashire Branches of the Institute of British Foundrymen.

are prominent in this lay-out. The first is the complete isolation of the plant from the scrap yard. This means that the furnace bay is kept almost like a laboratory installation free from the impediments of a storage. The second is the use made of the drop in ground level between the two bays. This assists greatly in the charging facilities.

The personnel required for normal working is as follows:—2 crane drivers, 1 operator, 2 tappers, 1 charge operator, 4 labourers, 1 pulveriser operator, 1 weighman and 1 boy. Averaging out the wages of these men at £3 per week (this figure allows ample for any odd hours' overtime which may be necessary at dinner times) and taking the weekly tonnage at 420 of molten metal makes a direct labour cost of 1s. 9d. per ton melted.

Based on a life of 140 heats without patching, *i.e.*, 700 tons metal, and that 20 tons of refractory is required each lining at £3 per ton, plus £15 labour, the lining costs work out at 2s. 1d. per ton of metal produced.

It has been given on good authority that 3s. per ton is a generous allowance for interest and depreciation, and for obvious reasons the author cannot give this in detail but must accept this as being a fair figure. A balance sheet for metal in ladle would then be as follows:—

	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
Raw materials	50 0	60 0	70 0
Coal at 20s. per ton, plus 3s. pulverising, 15 per cent. of charge	3 6	3 6	3 6
Power at 0.75d. per unit ..	1 0	1 0	1 0
Labour plus 50 per cent. overhead	2 8	2 8	2 8
Lining costs	2 1	2 1	2 1
Limestone, 1½ per cent. ..	0 2	0 2	0 2
Depreciation and interest ..	3 0	3 0	3 0
	62 5	72 5	82 5

Whether raw materials are 50s., 60s. or 70s. depends greatly on available materials and in some measure on the skill of the controlling metallurgist. Cupola costs vary so much in every foundry and one's audience usually knows their own individual costs, that these have been purposely omitted.

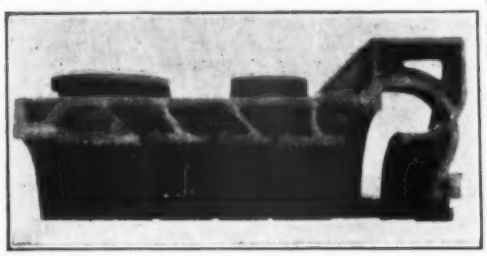


Fig. 3.—Turbine Cylinder Cut Up in order to Reveal any Defects.

Practical Examples of Castings.

In the short time available, it is impossible to go into too many details of castings produced but to show the wide range of castings covered by this method of melting, three distinct examples are shown in Figs. 2 to 4. The first one is an automobile-cylinder block, weighing about 5½ cwts., with material thicknesses varying from ⅞ in. up to ⅝ in. The casting includes 6 cylinder bores, crankcase, valve chambers, timing gear, etc., all in one casting. The analysis of the metal in these castings is as follows:—T.C. 2.9, Si 2.5 to 3, Mn 0.7, S 0.06 and P 0.35 per cent.

The tensile tests taken from these castings range from 18 to 20 tons per sq. in. In one case a test was taken with a standard repeated impact machine, and the test-piece stood 2,234 blows before fracture. This casting is close grained in varying sections and easily machined.

For medium-range castings, with thicknesses from 1 in. to 2 in., the example shown in Fig. 3 is a turbine cylinder. This turbine cylinder was noted for its difficulty when issued for previous orders, and it was with a view to testing out the value of rotary furnace iron that one of these was made expressly to be machined and cut up.

It shows the turbine piece after machining, with the cut section facing the camera. Every one of the sections where two walls meet was perfectly sound. No special feeding heads were required, in fact the casting turned the scale at 4 tons 4 cwts. and the metal was produced in a 5-ton furnace. This proves the fact that no intricate system of feeding heads could have been used. The analysis was as follows:—T.C. 3, Si 1.36, Mn 0.79, S 0.078 and P 0.46 per cent.

The details of the test figures are shown in Table II.

Table II.—*Material Tests on Experimental H.P. Turbine Cylinder.*

Tensile.

On ½ in. Square Test-Bar. 19.0—19.2 tons per sq. in.

Transverse Test.

Size of Bar.	Tons.	Deflection.
36 in. × 2 in. × 1 in.	1.84	0.46 in.
12 in. × 2 in. × 1 in.	6.44	0.13 in.
12 in. × 1 in. × 1 in.	1.72	0.12 in.
18 in. × 1.2 in. dia.	1.80	0.28 in.

Drop Test.

1⅝ in. square bar, 6¼ in. centres. 40 lbs. at 22.95 in. drop.

Compression Test.

73 and 72 tons per square inch.

Repeated Impact.

1,354 blows with 1½ in. drop.

Since the above experiment was carried out, about 20 different turbine pieces have been made in the same manner, and test-pieces have been taken up to 22 tons per sq. in. These castings have been entirely satisfactory under machining and water test.

The third and last example (Fig. 4) is the thickest job which the author has encountered. This is a machined body, the industrial purpose of which the author is not familiar. It has varying sections from 2 in. up to 12 in. thick. The minimum tensile under which the casting would be accepted was 18 tons, and it was, therefore, a clear case for rotary furnace production. No further details are available regarding the behaviour of this casting in the machine shop. The analysis was as follows:—T.C. 2.7, Si 1.3, Mn 0.7, S 0.067 and P 0.25 per cent. The tensile test was returned at 19.6 tons per sq. in., and the weight 5 tons 10 cwts. These three castings it is thought are sufficient to prove that the rotary furnace is not confined to either very thin castings or, on the other hand, very thick, but the benefits of the furnace can be fully realised on any class of grey-iron work. The test figures quoted are not laboratory experiments, but are actual commercial castings made in the usual way. Such castings as these shown are being made daily.

PART II.—METALLURGICAL CONSIDERATIONS.

By Stanley E. Dawson.

In dealing with the metallurgical considerations of the rotary furnace it is convenient to take the process of manufacture first so that a better understanding of the products available may be obtained. It has already been observed that the mechanism of the process consists of introducing heat into the rotating furnace with the object of raising the refractory lining to a very high temperature, the hot products of combustion then passing forward into the flues to the chimney stack.

The intense heat in the furnace lining is transmitted during rotation directly to the metal bath by actual contact, thus overcoming the heat-insulating power of the slag, which, however, protects the metal from contamination by gases. The heat, as pointed out, is generated by the burning of pulverised coal on a refractory lath-type grid situated in the combustion chamber, somewhat on the principle of a bunsen burner with its gauze flame carrier.

The coal is carried in and burned by means of an air supply raised to a suitable temperature in a regenerator situated in the exhaust flues and driven forward by the blower. The coal, except for that used in the initial lighting up, is anthracitic, and can be obtained from any suitable coal measure, typical analyses of such already having been given. Since the main feature is to concentrate the absorption of heat into the bath of metal, it is necessary to control the combustion of the coal, that is the flame, at a position predetermined in the design of the furnace. This position is immediately in front of the grid in the combustion chamber.

Owing to the easier ignition of the higher-volatile coals the position would vary with this factor. Consequently, for increased volatile in the fuel, the temperature of the combustion air must be lowered. To maintain the correct position, the following examples show the balance which has to be observed. 7 per cent. volatile requires 550 deg. C. air temperature; 11 per cent. volatile requires 450 deg. C. air temperature; 15 per cent. volatile requires 350 deg. C. air temperature.

The degree of pulverisation has also some influence on the position of combustion, but with suitable modern pulverising plant this can be closely regulated. A suitable condition of the coal is obtained when about 75 to 80 per cent. will pass through a 200 mesh with the coarser grades suitably balanced. The air temperature is controlled by the use of damper plates in the exhaust flues which include a by-pass direct to the chimney.

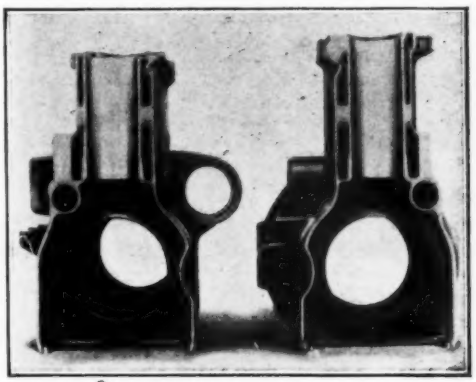


Fig. 4.—Machine Body of Heavy Section Thickness.

Table III.—*Slag Comparison.*

	Rotary slag (Sesci).	Cupola slag.	Siemens slag.
Silica (SiO_2)	59.45	62.0	57
Ferrous oxide (FeO) ..	1.28	16.5	25
Alumina (Al_2O_3) ..	10.97	5.0	1
Manganese oxide (MnO)	4.70	7.0	10
Lime (CaO)	22.40	9.0	5
Magnesia (MgO) ..	1.20	3.0	2
Sulphur (S)	Nil	0.5	Nil

The type of slag produced in the rotary furnace is rather different from that produced in the cupola in that it contains much less iron oxide which indicates practically a neutral atmosphere in the furnace, an abnormally-low metal

loss, and avoidance of undue oxidation of the metal or its ingredients by the transference of oxygen in the cycle of reactions between the metal and the slag.

Table III shows the slag in comparison with those from the cupola and the Siemens open-hearth furnace.

The lining of the rotary furnace, put in by the aid of templates as in the Bessemer converter, is composed of such a material as to embody high refractoriness, resistance to the abrasive action of the charge and the air-blast, little or no expansion or contraction, and an elasticity to withstand varying temperatures. Such materials are usually of a siliceous nature containing about 30 per cent. of clay, and after ramming the lining is skin dried and fired, prior to glazing under full heat.

From the foregoing it will be seen that the rotary furnace provides conditions for producing metal, not only free from the effects of contamination necessarily associated with cupola practice, but one of a predetermined composition, and of a range hitherto not economically possible. The cupola with its circumscribed heat range, and direct contact between descending metal and ascending gases has largely controlled and limited the composition and structure of cast iron produced therefrom.

It has long been recognised that vastly different structures could be obtained with the

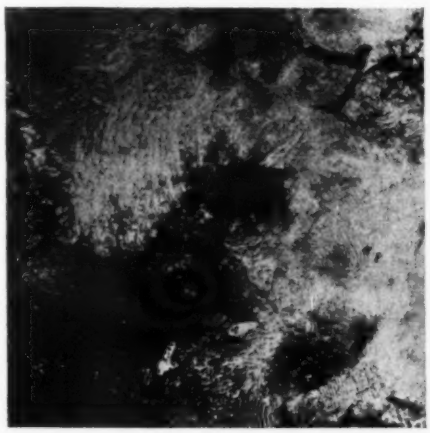


FIG. 5.—CYLINDER IRON. × 650.

same composition if only means of production were available economically and conveniently to provide a suitable range of the necessary conditions. In the many investigations into this new field of the structure of cast iron, of which the British Cast Iron Research Association has rendered invaluable service, it was early established that superheating of the metal and the amount and nature of carbon present, were the most prominent factors.

The effect of superheating cast iron is to produce in the final solid material a ferrite—fine graphite structure, to an extent dependent on the degree and length of time of such superheat. Such a structure, in addition to thus embodying the softer components of the iron has the added interest and value of exhibiting a lower shrinkage and a more even grain-size for different metal thicknesses, a property hitherto attainable only by alloy additions or special processes. The theory underlying this fine-graphite formation is generally ascribed to the more complete solution of the original flake graphite in the materials employed, with the consequent removal or reduction in size of graphite "nuclei" which would induce and form the starting point of larger flake graphite.

This is only partially correct, however, and much investigatory work is proceeding in an effort to determine a more comprehensive understanding of the matter.

Some scientific evidence is, however, hereby shown for the use in most cupola charges of "scrap" which, whilst introducing a serious unknown factor into the calculation, is of finer-graphite form than "pig," due to its having been twice melted. The extent to which superheating should be carried out depends on the duties to be demanded of the castings produced from the metal, the proportion of pearlite retained being the main underlying factor.

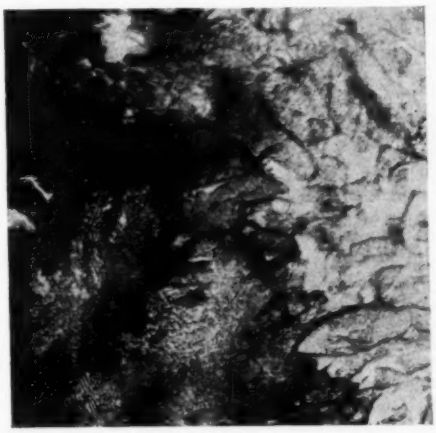


FIG. 6.—CYLINDER IRON. × 650.

Apart from the microstructure the amount of combined carbon is some guide in determining the correct conditions. Figs. 5 and 6 show examples of metal suitable for, and taken from, a motor-cylinder block, whilst Fig. 7 shows a structure which is largely pearlitic.

From the foregoing, it is natural to assume that a more complete control of total carbon in the metal would facilitate the production of a desired structure, if, for example, a low-carbon could be employed. The superheat attainable in

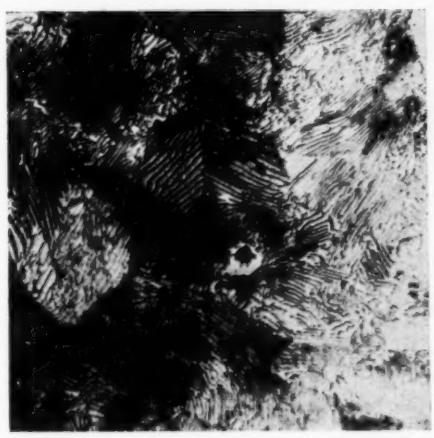


FIG. 7.—CYLINDER IRON—MAINLY PEARLITIC. × 650.

the rotary furnace renders this possible, since steel, or any other low-carbon material, can be melted with ease, and any degree of carbon introduced into the melt by this means, and adjusted, if necessary, by the addition of petroleum coke.

The use of steel in the cupola charge, even if under limited control, is one evidence of the value of lower carbon towards improved structure. Low total-carbon cast iron, in addition to producing fine graphite, also produces a finer grain structure which, as one would expect, and as shown, is responsible for great increase in strength. The new process of rotary melting has, therefore, provided a means of embodying the factors necessary to bridge the gap between grey cast iron and malleable cast iron, and, by superimposing the malleable process thereon, of attaining strengths usually only attributed to steel.

Similarly, for special-duty conditions, alloy cast iron of any desired composition can be made, either as a complete and separate melt, where quantities warrant it, or by adding the alloying element, including carbon, in a residual furnace bath or in the ladle. Another feature of superheated iron which is worthy of note is the less effect thereon of the elements usually present in cast iron, such as silicon, manganese and phosphorus, so that a wider range of castings can be produced from the same composition, an advantage to be considered in many foundries at the present time. In the form of pig-iron, whether of alloy composition or not, a ready means of producing fine-grain cast iron from the cupola is thus rendered available.

With the wider range of compositions available some modification of existing test-pieces became necessary, and it is interesting to record one introduced to measure the fluidity of the metal. This was designed by Sipp, in Germany, and is of the design shown in Fig. 8, from which it will be seen that the test-piece is run under standard conditions so that all measurements are comparative. The complete test-piece of 1,500

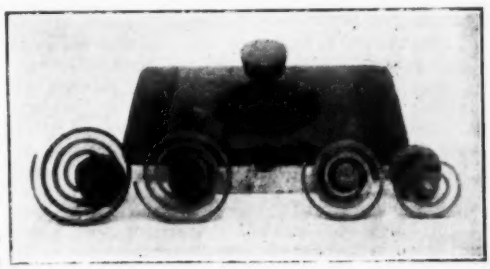


FIG. 8.—FLUIDITY TEST-PIECES AND PATTERN.

mm. long (about 60 in.) has been attained on ordinary shop metal employed on thin castings. A variety of mixtures illustrating the scope possible in the rotary furnace is shown in Table IV, together with the strengths obtained.

TABLE IV. *Mixtures Cast and their Mechanical Strengths.*

Pig iron, per cent.	60	100	85	—	—
Scrap, per cent. ..	25	—	5	—	—
Steel, per cent. ..	15	—	—	100	—
Borings, per cent.	—	—	10	—	100
FeSi, lbs.	80	120	—	—	86
FeMn, lbs. ..	—	—	—	5	—
Coke, lbs.	—	—	—	—	48
T.C, per cent. ..	3.00	3.24	2.71	0.1	3.27
Si, ,, ..	2.44	1.76	1.70	0.1	4.30
Mn, ,, ..	0.50	0.58	0.65	0.35	0.34
S, ,, ..	0.089	0.069	0.110	0.04	0.089
P, ,, ..	0.30	0.32	0.45	0.112	1.07
Tensile (tons per sq. in.)	20.4	21.0	22.35	*27.4	19.8

* In this case the elongation was 48 per cent. and the reduction of area 53 per cent.

DISCUSSION IN LONDON.

Scrap Control.

MR. CLEAVER asked how the authors controlled the analysis of scrap in the rotary furnace.

MR. DAWSON replied that, as when using a cupola, one did the best one could, but when using a rotary furnace, a sample can be taken before tapping, somewhat similar to a spoon sample from the open-hearth steel furnace, and if the metal was not quite to analysis, as indicated either by fracture or by quick analysis, the necessary corrections were made.

MR. SCOTT also pointed out that at most works there was a domestic scrap from the engineering shop, and in that case one had a very good idea what the analysis was.

Temperature, Life and Furnace Fettling.

MR. C. H. KAIN asked if it were possible to shank or cast in hand ladles direct from this rotary furnace—an important consideration for founders producing quantities of small castings—and, if so, whether it was possible to reduce the flame in order to maintain the proper temperature of the melt, whilst that was taking place without undue silting up or firing back of the burner. Commenting on the author's reference to temperatures as high as 1,650 deg. having been attained, he said that in the ordinary iron foundry 1,400 deg. was considered to be quite a high temperature, and 1,650 deg. would be considered abnormally high for cast iron or malleable iron practice. He asked whether, to attain this extra high temperature, excessive coal consumption was necessary; in other words, was 1,650 deg. the normal tapping temperature, or was it attained only at the expense of excessive coal consumption? With regard to the lay-out of the plant, he asked if all the furnaces were fired by means of fuel from a central pulveriser.

MR. SCOTT said that that was the case in this lay-out.

MR. KAIN finally asked how the authors proposed to fettle the furnace between charges, for it seemed to him to be rather a difficult furnace to fettle in the event of undue abrasion or fluxing on the inside.

MR. SCOTT, replying to the question concerning shanks, said that before this particular furnace was installed he had had the pleasure of seeing about eight other furnaces working on the rotary principle, and in every case the metal was shanked out in ladles of from 50 lbs. to 2 cwts.; this particular furnace at Messrs. Sir W. G. Armstrong Whitworth's works was the first he had seen from which the metal was tapped out in 5-ton lots. Shanking was, however, quite simple, and could be done by hand without any danger, though tapping in 50-lb. shanks from a 5-ton furnace would occupy a long time, and, since it was not the practice to "drop" the flame, it was not as economical as ladle tapping. Complete control, however, was obtained by electrical press-button equipment. The temperature of 1,650 deg. was not abnormal; there had been a little trouble due to getting the metal too hot. In the melting times quoted in the Paper, a temperature of at least 1,500 deg. was reached; the temperature of 1,650 deg. had been attained as the result of a slight increase in melting time—and it was surprising what an extra 10 or 15 minutes would do in the way of superheating the metal. He had melted steel and run test-bars with ordinary runners, in ignorance. In a malleable foundry he had seen a 100-lb. shank tapped out of a furnace of this kind, carried about 50 yds. across the foundry and used for pouring four boxes, the metal being still very fluid, though the iron contained only about 0.6 per cent. silicon and about 2.5 per cent. total carbon. Apart from temperature readings, fluidity testing was a guide to indicate the heat of the metal. So far it has been found impossible to fettle between heats while the furnace was hot. He was endeavouring to get 200 heats, fettling after the furnace was cooled. One could not get inside the furnace within a period of probably 24 hours after the completion of a heat, for, owing to its shape, the furnace conserved heat. Whether there would be produced in the course of time some form of gun with which to shoot on the refractories, he was unable to predict, but that matter was being considered by some technical people.

Melting Losses.

MR. DESCHAMPS asked what percentages of the elements carbon, silicon and manganese were lost during the melting process; he did not suppose they would be large percentages, however, in view of the analyses given. He asked how one could ensure that the iron produced in the furnace would have a fully-pearlitic matrix and not a ferritic matrix. He had always understood that if one superheated iron at a sufficiently high temperature and for a sufficient period of time, the whole of the carbon, and even the graphite nuclei, was completely dissolved; when the metal was cooled down, the carbon was precipitated as fine graphite in a matrix of ferrite—and that was not desired if one wished to obtain maximum strength in the iron. He asked if inoculation of the metal would give the desired structure, or whether the pearlitic matrix was obtained without special steps being taken. Referring to a heavy casting which the authors had produced, having a tensile strength of about 19 tons, and containing 1.3 per cent. silicon and 2.7 per cent. total carbon, he asked whether the moulding and pouring had presented any special difficulties from the point of view of contraction, and whether special feeding arrangements were necessary. Finally, he asked whether the authors had made experiments in which 100 per cent. steel scrap was used, and whether they had tried the use of a basic lining instead of an acid lining, for the basic lining seemed to offer possibilities of producing more cheaply.

MR. DAWSON replied that the extent of the melting losses depended entirely upon the skill with which the furnace was operated. When working at maximum economy, *i.e.*, with the correct amount of coal to produce the required heat and the correct amount of air to burn that coal, the carbon content remained constant; there was neither pick-up nor loss. There was a loss of silicon, however, in this furnace as in others, to the extent of from 15 or 20 per cent., though 15 per cent. was the more usual figure; there was also a loss of about 15 per cent. of the manganese.

MR. WILKINSON asked why, if the furnace were operated with all reasonable care, and with a reducing atmosphere, that loss of silicon and manganese was experienced?

MR. DAWSON replied that if the furnace were operating at just under the reducing point, the loss would not be so great, but under the conditions of the practical production of castings in the foundry—not laboratory tests, but under ordinary everyday-working conditions, without the employment of special technical men—these losses were incurred, but they were rather less than those incurred in the cupola.

MR. WILKINSON asked if the losses were allowed for in the metallurgical calculations?

Control of Microstructure.

MR. DAWSON said that they were. In other words, the furnace was under control from week to week; and knowing the losses to allow for one calculated accordingly. He emphasised, however, that much more accurate results were obtained in the rotary furnace than in the cupola. Dealing with the question of ferrite and pearlite, the furnace had not yet been operated for a sufficiently long period to enable one to ensure that everything in the cast iron it produced was in the desired form, and he was not yet able to say exactly whether graphite was disseminated in ferrite or to what extent pearlite was produced, but castings of high strength were produced, which probably indicated a large proportion of pearlitic structure.

MR. DESCHAMPS: In other words, you get the pearlitic structure, but cannot control it?

MR. DAWSON would not go so far as that, and could only say that he did not know yet how far it could be controlled. He hoped, however, that when Mr. Scott and himself discussed this furnace at a meeting of the Lancashire Branch of the Institute in April they would be able to say more about that.

MR. DESCHAMPS asked if it were possible to explain yet why the pearlitic structure was produced?

MR. DAWSON replied that he could not explain it yet. Continuing, he said that all the melting had been done so far with an acid lining, and a basic lining had not been used. They were now investigating the use of a basic lining—of the dolomite variety, of course—for the possible removal of phosphorus.

Feeding the Castings.

MR. SCOTT, discussing the production of the heavy casting referred to, said that feeding heads had been used in that case. Over the very heavy section, which was of about 12 in. cube, whilst one or two risers, of about 4 in., were used. He had not the actual figures indicating the time occupied, but it had closed up much more quickly than would have been the case if an iron of much higher carbon content were used; his general impression was that it had closed up in about half the time that would be occupied by a higher-carbon-content iron.

MR. WILKINSON, who was interested in the particular charge mentioned in the Paper containing 0.1 per cent. carbon, said that the temperature of 1,650 deg. was fairly high, and he asked whether the material would run properly at that temperature. He referred also to the monoblock mentioned by the authors, having sections a few 16ths of an inch thick, the sections being rather smoother than was sometimes the case, and asked if they could have run it from the charge containing 0.1 per cent. carbon, melted in the rotary furnace.

MR. SCOTT replied that the answer to the question as to whether or not the charge would have run the whole of a cylinder block was a matter of surmise, and, candidly, he doubted it. The runners used on the test-bars in this case were of about ½ in., but there was a pricker hole at the top of the casting to provide for the escape of any air that might have accumulated. He produced a sample of the test-bar, and said that it was bent without having been annealed.

Rotary Action and Rapid Melting.

DR. P. M. MCNAIR, as one who had been interested in the rotary type of furnace, confirmed all that the authors had said with regard to its results. He criticised one or two of the authors' statements, however, as being erroneous. For example, it had been stated in the Paper that the heat was imparted to the metal principally from the roof and walls of the furnace, but Dr. McNair contended that the heating was effected principally by the flame itself. This had a temperature of 1,750 deg.; it passed heat to the walls of the furnace, but could never raise the temperature of the walls to that figure when the maximum temperature of the metal was 1,650 deg. He also disagreed with the suggestion that ferrite formed the basis of cast iron, except in very few cases, and he held that pearlite formed the basis. With regard to the statement that the dotted structure was particularly strong as compared with the plate structure, he said he hoped nobody would ever try to produce the dotted structure; it could not be done. Finally, with regard to rational analysis, he said that in this respect the metallurgists were running away with themselves. We knew definitely what chemical analysis meant, and by means of it we tried to calculate factors such as Fe_2O_3; it was not fair to try to put all these things on to the foundrymen as representing the conditions in which these metals existed.

MR. SCOTT, replying, pointed out that although Dr. McNair had stated that the heat was not imparted to the metal principally through the lining, he had not explained why the ordinary air furnace fitted with a pulverised-fuel burner occupied 5 hrs. to melt the quantity that could be melted in a rotary furnace in 2 hrs. Mr. Scott held, therefore, that the rotation was the principal feature of the rotary furnace, in that it took the heat of the roof underneath the metal, and that was where the melting took place principally.

Vote of Thanks.

The discussion was curtailed owing to lack of further time, and on the proposal of MR. V. C. FAULKNER, seconded by MR. DESCHAMPS, a hearty vote of thanks was accorded the authors for their Paper.

Annealing Furnace for Malleable Iron.

RECUPERATIVE TYPE.

With the revolutionary advances, which during the past few years have been made in furnace design and furnace practice, it is certainly remarkable that furnaces contructed on the direct-firing system have survived so long, because it would be no exaggeration to say that such furnaces consume at least 30 to 50 per cent. more fuel than the best types of recuperative gas-fired furnaces. The saving, however, is not only in the quantity of fuel, but also in the quality, for whereas best hard coal is the most economical fuel for the direct-fired furnace, the gas-fired furnace is best fired with "nuts."

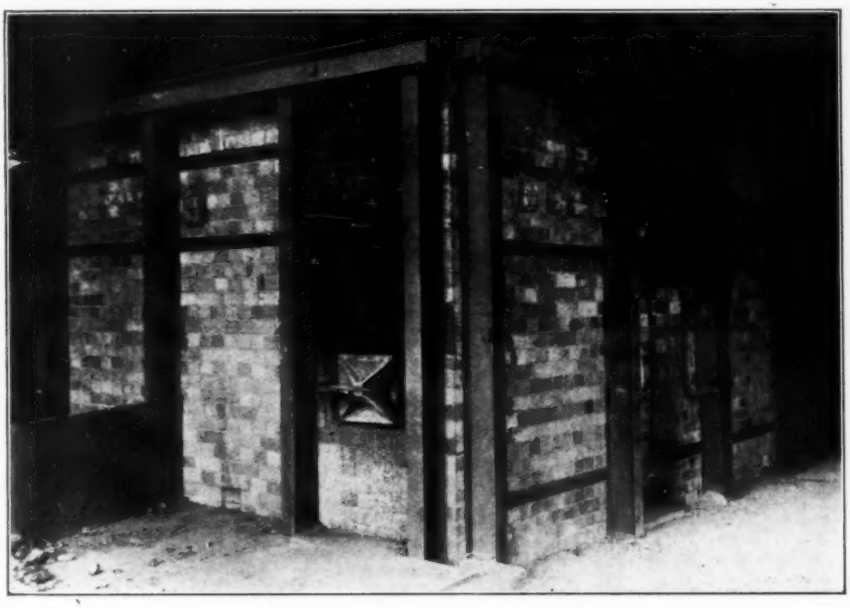


FIG. 1.—ANNEALING FURNACE FROM PRODUCER SIDE.

There is no doubt that the attitude of many furnace users with regard to a changeover to gas firing is the outcome of unfortunate experience gained with the earlier types of gas-fired furnaces, many of which were so complicated in design as to cause practical difficulty in working. Further, the initial expenditure was unduly high and the ground space occupied for output excessive. On the other hand, cheaper and more simply constructed furnaces were generally lacking in durability or failed to effect the desirable and possible economies in fuel. However, with the best types of modern furnace these objections can no longer be sustained, and the claims of the gas-fired furnace cannot be longer ignored.

On a recent visit to the Imperial Works, Walsall, of Messrs. Alfred H. Mould & Sons, Limited, our representative had an opportunity of inspecting the Hermansen recuperative malleable annealing oven, which was designed and built by A. Hermansen, County Chambers, Corporation Street, Birmingham, and was in point of fact the first oven of this design to be installed in Great Britain. Whilst the possible economies of the system were naturally an important consideration, they were in this case not the determining factor. A considerable portion of the output of the Imperial Works is on account of foreign Governments, and has therefore to comply with rigid specifications, and it was mainly the possibilities which the gas-fired system appeared to offer for a uniform and higher class production which determined Mr. Mould to become a pioneer in the adoption of the Hermansen furnace.

The existing battery of ovens at the Imperial Works was of the direct-fired type, the fuel, as is usual, being best hard coal, the furnaces themselves were of modern design, and the practice generally of an up-to-date character. One of the existing furnaces was dismantled, and the new gas-fired recuperative furnace was built on to the battery. The furnace is fired from an inbuilt step-grate producer and supplied with one Hermansen recuperator, the object being to make use of the heat from the waste gases for preheating the secondary air; this is a principle which Hermansen has adopted in upwards of 10,000 furnaces for various industries, but, as previously stated, the installation under notice is the first application of the system to the malleable-iron industry. The furnace has a hearth 11 ft. by 6 ft. by 6 ft. 6 in. high, holding on the average 25 tons gross weight, of which the pots and packing material weigh approximately 20 tons and the goods themselves about 5 tons.

The Hermansen patent continuous recuperators consist of specially-manufactured hollow firebricks, which are made with ribs on the outside, top and bottom. These bricks are so built together as to form a number of parallel square flues through which the waste gases pass in a downward direction on leaving the furnace, and transverse flues through which the secondary air passes in very thin layers. These transverse flues are joined together on either side of the gas flues by longitudinal flues. The secondary air, regulated by slides, is introduced into the lowest of the heating flues, and runs alternatively left and right through the horizontal transverse flues in an upward direction, finally reaching the combustion chamber through the special flues. In this manner the principle of counter-currents is utilised in the best possible way. The gases of combustion, in consequence of the great surface of the extremely thin walls dividing the air from the waste-gas flues, are utilised to the utmost, and the secondary air is heated to a corresponding high degree. Leakages in the recuperator are prevented, as the firebricks are rebated at the ends.

The front and back walls of the recuperator are formed with similar firebricks in a similar manner, so arranged that if any flue dust is formed it can easily be removed from any of the flues without interfering with the working of the furnace, whilst the flues can be observed through spy holes. The time required to raise the furnace to working temperature, an argument often used against the producer furnace, is entirely non-existent in the furnace under notice as, starting from cold, a temperature of 900 to 950 deg. C. can easily be obtained within 24 hrs. and in considerably less time when the furnace is ready for firing whilst the air flues are still hot, which as a matter of fact is the practice adopted at Imperial Works, and a simple but very ingenious arrangement has been adopted to facilitate such charging.

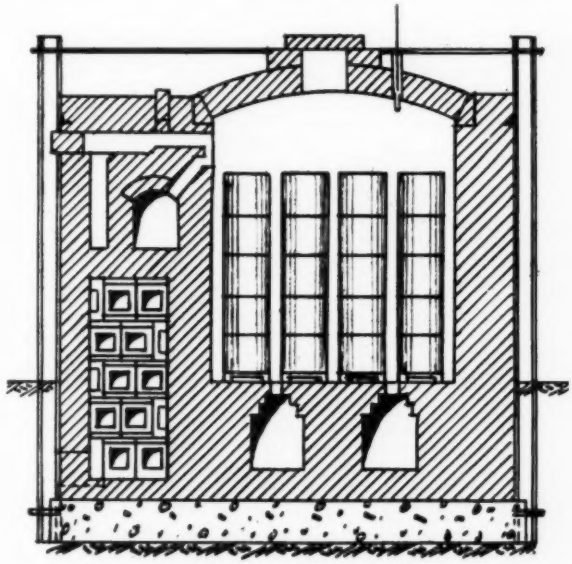


FIG. 2.—SECTION THROUGH HERMANSEN RECUPERATIVE ANNEALING FURNACE.

The pots are filled as the bottom of a tier of five pots rests upon a cast-iron stool. The charger consists of a built-up framework provided at its lower end with a fork member to pass under the stool, and carrying a cradle

against which the pots rest during transit into the furnace; the framework extends rearwardly for a length exceeding that of the depth of the furnace, the extension terminates in a handle, and is sufficient to balance the load of pots with very little manual effort. When the stack of pots is delivered to the required point in the furnace, a catch allows the carrying fork to fall clear, leaving the charge and carrying stool in the furnace chamber. The furnace is, of course, discharged in a like manner, and a considerable saving in time and fuel is effected thereby.

Fig. 3.—Front View of Annealing Furnace.

The time required for annealing naturally depends to a great extent upon the class of castings under treatment, working at the temperature referred to above and a five-day period of annealing, which is a fair average; the fuel consumption works out at rather less than 13 cwts. of "nuts" coal per ton of castings, which compares with 25 cwts. of best hard coal for the direct-fired furnaces under the same conditions. In practice the new system has been responsible for a better product of a thoroughly-uniform quality, and as there is less oxidation the life of the pots is appreciably increased.

We are indebted to Mr. W. H. Perry, of Messrs. Alfred H. Mould & Sons, Limited, for furnishing our representative with the particulars upon which our article is based.

Scottish Foundrymen Visit Modernised Foundry.

A party of about 120 members of the Scottish Branch of the I.B.F. visited the works of Messrs. Glenfield & Kennedy, Limited, Kilmarnock, on May 21, at the invitation of the directors of the firm. The party was met on arrival by Mr. E. Bruce Ball, managing director, Mr. H. Gardner, general works manager, Mr. Frank Hudson, chief chemist and metallurgist, Mr. R. D. Lawrie, foundry manager, and other members of the staff, who conducted the members through the various departments of the works. Naturally the main object of interest was the foundry department where the recently-erected sand-preparation plant was critically examined by many of the party, but other departments were of much interest, and particularly the various castings in the course of machining. The laboratory was also the centre of interest and admiration. Special arrangements had been made by the firm to have a certain number of men working in certain departments in order that the visitors could the better appreciate the processes and nature of work carried out by the firm. After the tour through the works the party assembled in the canteen for tea and light refreshments. Mr. Bruce Ball presided and was supported by Mr. H. Gardner.

Mr. N. McManus, Branch-President, in proposing a vote of thanks to the firm, said that the visit had been not only interesting and instructive but thoroughly enjoyable. Messrs. Glenfield & Kennedy were known all over the world as specialists in their line of business. When it became known to the members of the Branch that the invitation to visit the works had been extended to them there was an unusual demand for tickets for that busman's holiday, so much so that the secretary became alarmed in case they should presume on the hospitality of Messrs. Glenfield & Kennedy. It had acted as a tonic and refreshment to find at a time when nothing but depression and unemployment was talked about a firm like Glenfield & Kennedy setting to work and modernising their works, spending large sums of money and determined to keep right up to date in plant and methods so as to cheapen their products. They, as foundrymen, had been specially interested in the sand-handling plant, and appreciated the fact that Messrs. Glenfield & Kennedy had faith in the old country and did not consider it down and out, but it would eventually recover from the present state of depression. He trusted that their optimism would be well rewarded. He desired to thank Mr. Gardner not only for what he had done in arranging for their visit that day, but also for the service he had rendered the Branch during his own year of office. To his staff and all who had contributed to their enjoyment and comfort he tendered the thanks of himself personally and of all the members of the Institute. Lastly, he desired to couple the name of Mr. Bruce Ball, because after all he was the man behind Glenfield & Kennedy, and to whom they were indebted for the privilege of visiting the works. He had an announcement to make, like most programmes of the time they had their surprise item. In connection with the Sir Archibald M'Innes Shaw prize fund which the Branch had established a year ago the educational authorities of Glasgow desired that the prizes should be delivered to the successful candidates in the presence of the members of the Scottish Branch, and had asked that the prizes be distributed at that meeting. Messrs. Glenfield & Kennedy had readily assented to the suggestion, and Mr. Bruce Ball had agreed to hand over the prizes. He asked them to express to Mr. Bruce Ball, Mr. Gardner and his staff and everyone who had contributed to the success and enjoyment of the visit, their sincere thanks.

Income Tax and Plant Depreciation.

Mr. E. Bruce Ball said that it gave him great pleasure to acknowledge the vote of thanks which had been so graciously proposed by the President, and he desired to join him in the hope that a brighter time will soon arrive. It would give him very great pleasure to convey to his co-directors their kind expression of thanks and appreciation. It was really to Mr. Gardner that their thanks were due for this visit, and he was glad that Mr. McManus mentioned his name, for he had put in a great deal of time and thought in the making of the arrangements for their reception. The question of progress was very important to any firm hoping to maintain their position in the world's markets. They had certainly spent a considerable sum of money in new plant and new schemes, but they found that having gone so far they could not stop there, and had to go on spending. What they were doing was to put the sum allowed due to depreciation back into the business each year. The income tax people did not allow them very much, but what they did get they used for renewal and extension of plant. They had seen some of their foundry equipment, no doubt some would consider parts of it obsolete, but perhaps it would not be there long and at their next visit they would find it replaced by other plant. The business of the firm was not an open one and depended not only on the home market but on the markets abroad. During the last few years competition had been very severe and increased tariffs, etc., against them had nearly driven them to the wall. Our own Dominions, however, had been rather sporting, and, although they had put up tariffs to protect themselves, they had invited the firm to build works and manufacture behind the tariff wall. If, however, they did that, there would be nothing left for them in Kilmarnock, where normally about 1,700 people were employed. The Glenfield works were kept going by a multiplicity of small orders from a large number of places. They had all got to get their toes into the job and secure economy and the best production. They had the grit to do it and he believed they had the gumption. It was when things were most difficult that the grit came out and progress made. He wished to express to them his own personal appreciation for the way they had turned out to that visit, he would have been very disappointed if the party had been small. It was a great pleasure to open the works and show them all that they could, it was a good advertisement for the firm and everyone connected with their staff was proud of what they were doing in Glenfield works, and when they found a staff all smiles like that it meant for the best efficiency. The President mentioned about the prizes for classes attended at two centres in Glasgow where patternmaking and foundry work were taught. He was very glad to know that the Institute founded the scheme in Glasgow.

Mr. Ball then handed over the prizes, and in conclusion said that he would like Mr. Gardner to speak to them and associate himself with the vote of thanks. He could probably tell them something which he did not know about.

Mr. H. Gardner said they had been delighted to see the large number present that day, but it was not a case of quantity only, the quality was also good; he had been impressed with the enthusiasm shown by the visitors and the manner in which things had been discussed. He thanked them on behalf of the staff and all who had assisted him in arranging the visit.

Factors Controlling the Crystallisation of the Graphite in Pig-Irons.

By COLIN D. ABELL.

The following notes are designed to illustrate the actual course of the process in the blast furnace and to show what happens in practice in the formation of the graphite in pig-irons. The notes published on page 223 of THE FOUNDRY TRADE JOURNAL, 1932, for April 7, by Hanemann with regard to the formation of the graphite in molten cast irons are very interesting, but scarcely carry the question far enough.

The factors controlling the precipitation of the graphite in molten pig-iron are as follow: (*a*) the critical temperature of the hearth of the furnace; (*b*) the amount of moisture in the blast; (*c*) the relative amount of graphite deposited in the shaft zones of the furnace, and obtained in the iron residues of the impregnated-coke phase (*vide* "F.T.J.," 1930, December 11, page 410); (*d*) the temperature of the core zones and the rate of driving of the furnace, together with (*e*) the composition of the slag, upon which its free-running temperature and hence the temperature of the hearth depends, and (*f*) the frequency of the times of flushing the slag at the cinder-notch is also of very great importance, as since the heat content of the slag at the free-running temperature is about 900 B.T.U. per lb., the amount of heat required by the hearth can be adjusted very easily within certain limits defined mainly by the composition of the slag. The iron-to-slag ratio is of little importance since one is dealing with the distribution of the various constituents of the charges, that is, with their concentration in each phase, of the molten iron and slag. The critical temperature of the furnace upon which the composition of the gas phase depends, is determined by the rate of driving of the furnace and the fuel-to-air ratio (by weight, not volume), and this itself determines the equilibrium composition of the gas phase such that the concentration of the graphite in the iron residues in the core zones of the hearth is saturated with regard to the carbon monoxide; in other words, that the 23 per cent. of graphitic carbon of the iron residues and the carbon of the impregnated coke phase produces an isogenic combustion of the blast to the following approximate composition:—

CO, 40.06 per cent.; CO_2, 6.50 per cent.; N, 53.83 per cent.; and in the core zones and intermediate zones of the hearth as CO, 20.74 per cent.; CO_2, 16.29 per cent.; N, 62.61 per cent. That obtained at the tuyeres being as follows:—CO, 10.19 per cent.; CO_2, 31.88 per cent.; N, 56.00 per cent.

The conditions are such then that in the inner and intermediate zones, viewed concentrically to the axis of the furnace, the eutectic composition with regard to the constituents of the iron residues and the molten iron is determined by the critical temperature (that is to say, the mean temperature of the hearth), and the composition of the molten slag present. The rate of driving of the furnace predetermines the amount of graphite deposited in the shaft zones to a large extent, the two factors being inversely proportional to one another. The chief factor in this respect is the amount of moisture contained in the blast; the presence of the moisture accelerates the formation of the carbon dioxide in the intermediate zones and the core zones of the hearth, the process being one of catalysis in the presence of the incandescent carbon, and at the same time it inhibits very markedly the reduction of the iron and manganese oxides below 1,000 deg. C. in the shaft zones. Dry blast increases the proportion of the carbon monoxide formed in the inner zones of the hearth, rendering the gas phase isogenic with regard to the combustion of the coke in the furnace; allows of the reduction of the iron and manganese oxides at as low a temperature as 560 deg. C., and reduces the amount of carbon required in the shaft zones as deposited graphite, the saving being thus about 10 to 12 per cent. of the fuel consumed by the furnace. In normal practice, using moist air, at least one-third of the total fuel charged is required in the reactions of the shaft zones. The real saving is the lower temperature required in the hearth for satisfactory working; a greyer but tougher iron; easier control of the silicon and sulphur content of the pig-iron, and the use of ores containing high percentages of silicon, alumina and magnesia.

The factors controlling the molecular orientation of the carbon of the pig-iron are (*a*) the percentage concentration of the manganese in the iron, (*b*) the sulphur content of the iron, (*c*) the spinel content of the slag, or, in other words, the concentration of the magnesia and alumina in the slag.

The sulphur-carrying power of the slag is determined by the concentration of the magnesia and alumina, and it is the concentration of each constituent that one must consider since the reactions are mainly bifacial or line-contact reactions, except in the bosh zones, where one must consider the relative proportions of the iron residues, amber slag and the silicified fuel.

The study of blast-furnace practice and of pig-irons has shown that in grey irons the sulphide present is most probably as manganous sulphide, which, while forming a eutectic with molten iron and ferrous sulphide, is insoluble in both molten iron and slag, and tends to segregate in the upper portions of the pigs when cast. Experience, more especially with grey irons, confirms the writer's opinion that the manganous sulphide forms a homogeneous framework of nucleic sulphide upon which the structural erection of the graphite is built, and the proportion of the manganese to the sulphur determines more generally than the silicon, the orientation of the graphite in pig-irons.

Austenite—Pearlite Inversion.*

By PROF. SIR H. C. H. CARPENTER and DR. J. M. ROBERTSON.

Summary.

This Paper deals in the first place with the constitutional aspects of the formation of pearlite. The iron-carbon diagram shows that in the absence of other elements this change takes place at a constant temperature, but this applies only to equilibrium conditions. Under ordinary conditions of cooling the change is spread over a range of temperature, but if cooling is stopped within this range, the change proceeds to completion. The addition of other elements also causes the change to be spread over a range of temperature, but in this case it does not complete itself if cooling is stopped within the range.

The structural features of the formation of pearlite are then discussed. One view of this is that the ferrite-cementite lamellæ are formed along the crystallographic planes in the austenite. In general, however, each austenite grain gives rise to a number of sets of lamellæ, which are not straight, and which do not meet at angles that suggest any relation to the crystallographic planes. Consequently it is concluded that the directions of the lamellæ are controlled by other factors.

Three ways in which the alternate plates of ferrite and cementite could be produced from austenite are discussed. First, the change might begin with the formation at intervals throughout the austenite of thin plates either of ferrite or of cementite, followed by the production between these of similar plates of the other constituent. It might then proceed by the increase in their thickness, ferrite and cementite being deposited alternately while the composition of the austenite oscillated between two values, one slightly to the right, the other slightly to the left, of the eutectoid. Secondly, the change might proceed by the precipitation of alternate layers of ferrite and cementite, so that the formation of pearlite would begin at a point and spread through the austenite, the direction of growth being at right angles to that of the plates. Thirdly, the ferrite and cementite might form simultaneously, and a growing particle of pearlite would consist of a group of plates advancing edgewise into the austenite. Careful study of a number of specimens showing pearlite in the course of formation indicated that the change takes place mainly, if not entirely, in the way last described. Numerous micrographs show this.

The effects of varying the carbon content and the rate of cooling on the form of the pearlite have been investigated. It was observed that, with slow cooling and low carbon content, the pearlite areas did not exhibit any tendency to assume any particular shape. As the rate of cooling and the carbon content were increased, however, the areas tended to grow radially, and perfect radial growth was obtained when pearlite began to form in the absence of pro-eutectoid ferrite. This radial shape is attributed (1) to the tendency for growth to take place so that the edge of the plates will always be presented to the direction of growth, and (2) to the fact that in this way the maximum amount of austenite is transformed in a given time.

As the rate of cooling is increased, ferrite crystals tend to assume elongated shapes, while pearlite crystals tend to become spherical. Because the conditions attending the formation of these constituents are different, their response to variations in the rate of cooling is different. When ferrite is forming, excess carbon is transferred to the austenite, whereas when pearlite is forming, there is no change in the composition of the austenite.

The constitutional aspects of the transformation of pearlite to austenite are then discussed, and it is shown that under ordinary conditions of heating the observed Ac_1 point occurs at a higher temperature than the equilibrium eutectoid point. Consequently, when specimens are heated at the temperature of the observed Ac_1, they are in a region where austenite containing either more or less than the eutectoid proportion of carbon may be formed. As cementite dissolves more slowly than ferrite, the formation of austenite containing isolated globules of cementite is a stage in the change under these conditions. The formation of austenite begins at points on the ferrite-pearlite boundaries, and from them irregular areas spread. Their shape bears no relation to the structure of the pearlite from which they are produced.

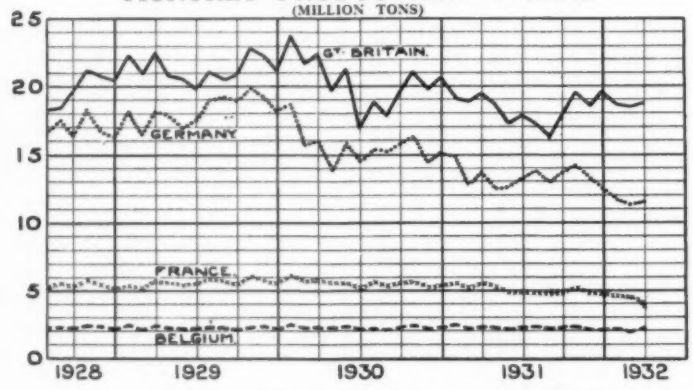
* Summary of Paper presented to the Spring Meeting of the Iron and Steel Institute.

Compensation for Silicosis.

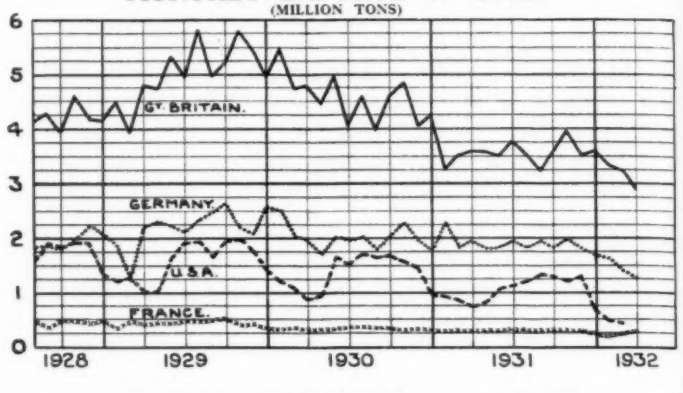
Dr. Charles L. Sutherland, of Sheffield, the Chief Medical Officer of the Medical Board for Silicosis and Asbestosis, summarised the provisions of the Acts dealing with workmen's compensation in pulmonary disease, and the results of their operation, in a Paper read before the congress of the Royal Institute of Public Health in Belfast. Dr. Sutherland pointed out that the only two pulmonary diseases covered by the Workmen's Compensation Acts were those of silicosis and asbestosis, and a successful claim could only be made if the sufferer had worked in an industry or process included in the compensation scheme. He explained the arrangements for medical examinations, and the finance of the Board, and stated that from February, 1919, up to the present time nearly £130,000 had been disbursed in compensation under the Refractories Industries (Silicosis) Scheme. All the workers in the refractories industries were examined periodically and a worker might be suspended from work if found to be suffering from silicosis, or silicosis accompanied by tuberculosis. Workers suffering from silicosis only had the option of remaining at work if they were above 45 years of age and had spent over 20 years at the occupation. The employers contributed to a general fund for the payment of silicosis claims and expenses, including the medical expenses, and the fund was supported by a compulsory levy on the wages of the workers, at the rate of 6¼ per cent.

XUM

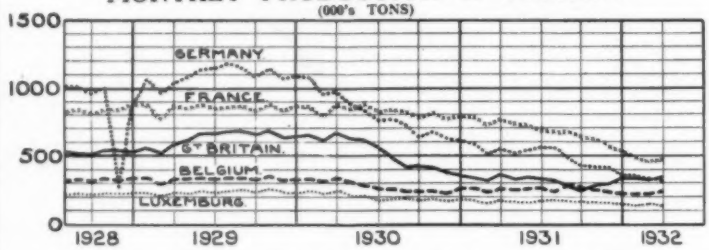
MONTHLY PRODUCTION OF COAL
(MILLION TONS)



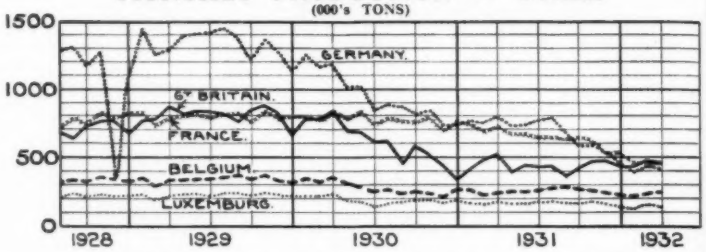
MONTHLY EXPORTS OF COAL
(MILLION TONS)



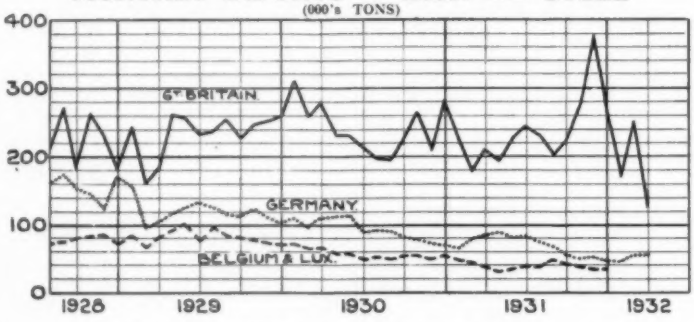
MONTHLY PRODUCTION OF PIG-IRON
(000's TONS)



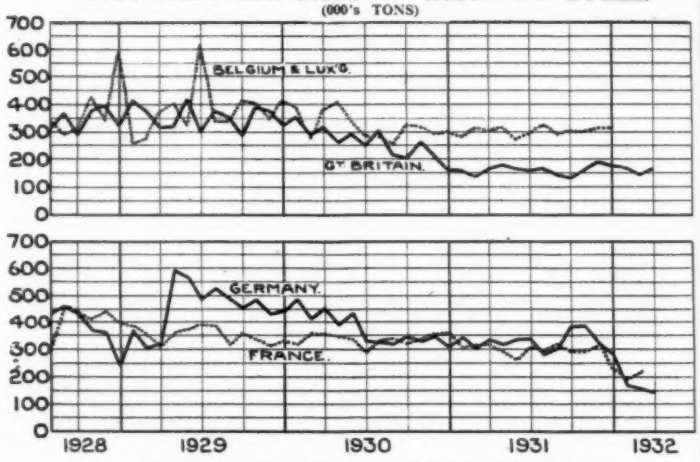
MONTHLY PRODUCTION OF STEEL
(000's TONS)



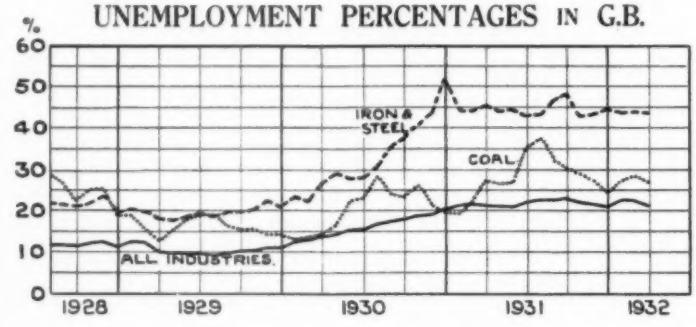
MONTHLY IMPORTS OF IRON AND STEEL
(000's TONS)



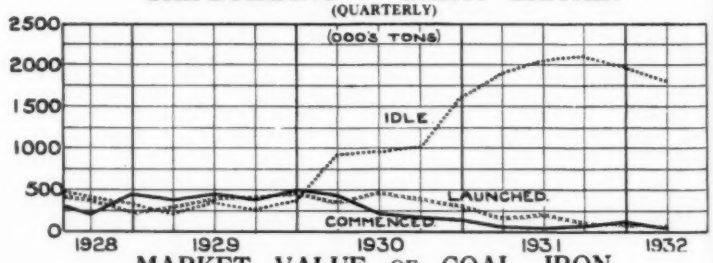
MONTHLY EXPORTS OF IRON AND STEEL
(000's TONS)



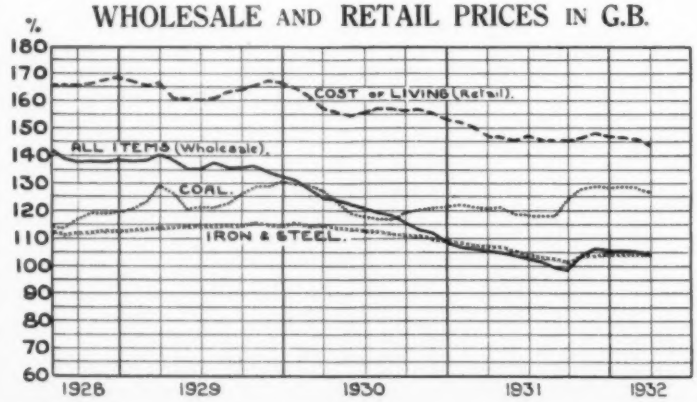
UNEMPLOYMENT PERCENTAGES IN G.B.



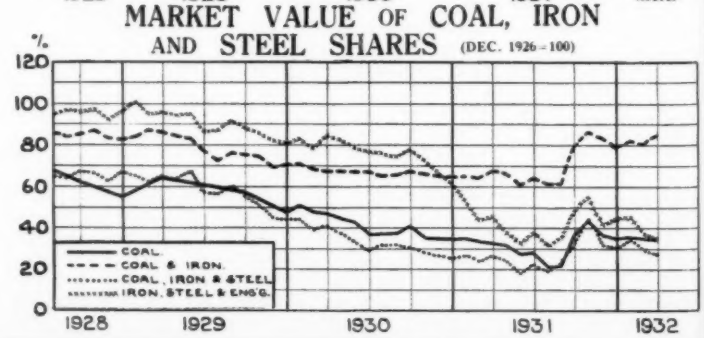
SHIPBUILDING IN GREAT BRITAIN
(QUARTERLY)



WHOLESALE AND RETAIL PRICES IN G.B.



MARKET VALUE OF COAL, IRON AND STEEL SHARES (DEC. 1926 - 100)



Green-Core Moulding.

Periodically in every foundry castings have to be produced without special cost for equipment. They can be moulded with a green-sand core instead of the more expensive dry core. Such a job has been described by A. Zankl in "Die Giesserei," 1932, Nos. 5 and 6, pages 46-49. The casting in question relates to a lever stand for an interlocking plant, the shape of which is illustrated in Figs. 1A, 1B and 1c. On account of the comparatively thin section, an iron pat-

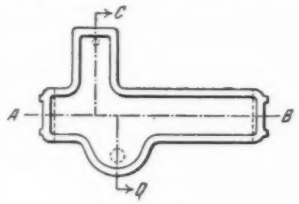


FIG. 1A.

tern was used, split and dowelled in the plane indicated in Figs. 1B and 1c.

Moulding is commenced by placing the pattern on a board and ramming-up the core in and around the pattern as shown in Figs. 2A and 2B. In making the core the pattern is held down by means of small weights in order to avoid lifting the upper half of the pattern when tucking the sand under it. Then parting sand is

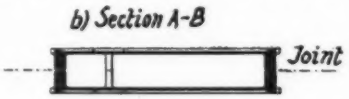


FIG. 1B.

dusted on the core, and lycopodium on the pattern; a box is placed on the board, rammed up, strickled off and turned over together with the board. Now the top-box is rammed up as shown in Fig. 3A, and, after placing on another board, the whole mould is turned over The bottom-box is taken off; imperfections are repaired; the mould is properly smoothed with the trowel, dusted

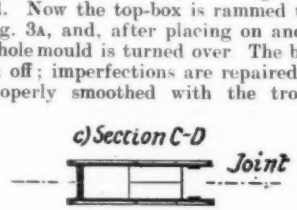


FIG. 1C.

with lycopodium and, after placing on a frame, cast up with plaster-of-paris. In order to avoid clogging of the lycopodium, it is advisable to spray the mould with petrol before casting. To stiffen the projecting boss of plaster, gaggers are cast in, hung on iron rods going through the side walls of the frame. The frame thus

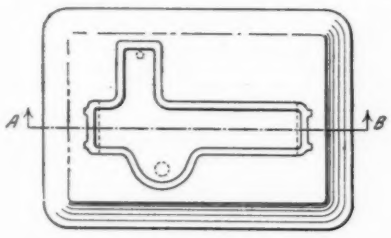


FIG. 2A.

made is the pattern-plate for the top-box of the mould proper. Now the core lying on the top-box (Fig. 3B) is mended, smoothed with the trowel, and dusted with lycopodium. After the fastening-hooks have been screwed in the pattern, a frame is placed on and cast up with plaster. Fig. 4A shows the finished pattern-plate for the bottom-box, the upper half of the pattern being taken off.

The mould proper is made on a turnover-moulding machine, the two pattern-plates being attached to both sides of the table: In the

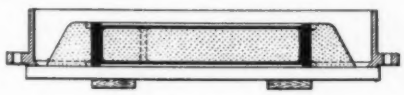


FIG. 2B.

bottom pattern-plate (Fig. 4A) the upper half of the pattern is inserted and weighted. Primarily around the pattern sand is hand-rammed, then more sand is filled in and rammed up until the pattern is completely embedded and the core is level with the top. Any excess sand is strickled off, the joint is smoothed with the trowel and

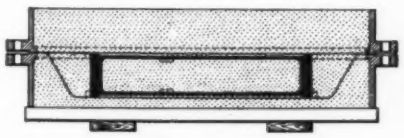


FIG. 3A.

dusted. Then the drag is placed on, rammed up, taken off and set aside. The sand around the edge of the pattern is swabbed, the upper half of the pattern is rapped and stripped. The drag is replaced and clamped to the plate, which,

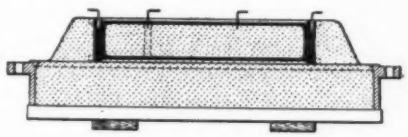


FIG. 3B.

after turning over, is taken off. The drag is now ready for use and corresponds to Fig. 3B, without the pattern therein shown. After ramming up the cope with the aid of the other pattern-plate (Fig. 4B) the mould is closed.

FIG. 4A.

In the case that the boxes available are insufficiently deep to take up the whole pattern, moulding is commenced by ramming up only half of the pattern as shown in Fig. 5. The following operations, however, are the same as described above. To avoid chilling the iron by the green

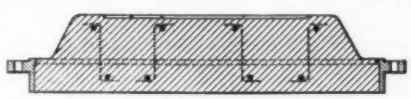


FIG. 4B.

sand, which is a real danger with the thin section in question, it is necessary to fill the mould as fast as possible. Since very hot iron is not

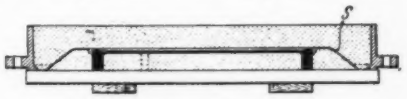


FIG. 5.

always available, it is advisable to pour the mould from both sides, connecting one gate with the top plate of the casting, the other with the bottom plate.

The Aachen Technical High School.

By J. G. PEARCE, M.Sc., Director of the British Cast Iron Research Association.

The work, accommodation and equipment of the Technical High School at Aachen (Aix-la-Chapelle) have previously been described in our columns.* For a number of years it has been the leading metallurgical school in Germany in an institution of university rank. Furthermore, it has provided theoretical and practical training in foundry metallurgy and practice as distinct from general metallurgy and mechanical engineering. Directed by Prof. E. Piwowarsky, and ably assisted by Dr. Nipper, the school has in recent years become what is virtually the only school of foundry engineering and metallurgy of university rank in Europe, probably in the world. Not only do they train foundry specialists, but they give foundry instruction to other metallurgical, engineering and mining students. The gradual infiltration into the German foundry industry of such highly-trained specialists must give us cause for very serious thought.

The writer was recently invited by Prof. Piwowarsky to attend the opening on May 21 of a new melting shop, worked in conjunction with the foundry laboratories and classrooms, and between 200 and 300 people were present, including representatives of the official bodies, comprising foundrymen, foundry employers in grey and malleable iron, steel and non-ferrous metals, and of the other technical institutions, and including Dr. Geilenkirchen, Dr. Korber and Dr. Bardenheuer, of the Iron Research Institute at Düsseldorf, Dr. Wirtz and Herr Langenohl, of the Vereinigte Stahlwerke, etc.

The proceedings opened, characteristically enough, with a Mozart string quartet played by students, in the large hall, and an address was given by the Rector of the Technical High School, Prof. Hoff. Subsequently, Prof. Piwowarsky reviewed the leading investigations carried out at Aachen during the past six years, and Dr. Nipper reported on a lengthy visit he has just paid to the United States. The party then adjourned to inspect the laboratories and to see the new melting hall, a large and lofty building, equipped for doing a wide range of work. A very decided novelty was an oil-fired cupola. This cupola had a small stack carrying a coke bed on which the charge was placed. An enlarged waist, resembling the ordinary wind-belt, carried six oil-burners, fed with air preheated by stack gases. The first melt of iron from this cupola was poured during the evening, the capacity being 3 tons per hr. By its side was the small cupola on which Prof. Piwowarsky's original investigations were made, and other equipment included annealing ovens, crucible furnaces, both oil and gas fired, moulding machines, sand-treatment equipment, an Ellipsoid furnace, storage bins for refractory materials, sands and foundry supplies, etc.

The function concluded with a social gathering at the Quellenhof Hotel. Further details of some of the above equipment will be given in a subsequent issue.

Steel-cored Aluminium Transmission Lines.—Apart from a few miles of special construction, the whole of the conductors in the British Grid are of steel-cored aluminium. The total length of cable for the primary lines is some 13,000 miles, involving the use of nearly 10,000 tons of aluminium, while the secondary lines so far specified account for a further 5,000 miles of cable, involving more than 2,000 tons of aluminium. An interesting book dealing with such cables with numerous photographs of transmission lines in this country and abroad has been published by the British Aluminium Company, Limited, Adelaide House, London, E.C.4.

* FOUNDRY TRADE JOURNAL, March 6, 1930.

This Week's News in Brief.

Trade Talk.

The Cunard liner "Caronia" (19,782 tons) has arrived at Blyth, where she is to be broken up by Messrs. Hughes, Bolckow, Limited.

The premises and plant of the Trent Ironworks, Scunthorpe, are being assigned to Messrs. John Lysaght, Limited, as from May 31.

Orders to the value of £100,000 have been secured by trade representatives who accompanied the Scottish exhibition ship to Canada.

It is proposed to reduce the capital of the Anderston Foundry Company, Limited, from £150,000 to £120,000 by repaying £1 per share in cash.

The Union Castle liner "Chepstow Castle" (11,300 tons deadweight), built in 1913 by Messrs. Short Bros., Sunderland, has been sold to Scottish shipbreakers for about £3,500.

Messrs. Gjers, Mills & Company, Limited, contemplate the restarting of two blast furnaces at their Ayresome Works, Middlesbrough, early in July. The furnaces will be put on the production of hematite.

It is understood that the Government of Uruguay intends to bring forward legislation providing preferential tariffs for British goods in the necessity class of imports, including coal, combustible oils and machinery.

The British Steel Export Association has booked an order for 35,000 to 40,000 tons of steel plates for Russia, on terms including 18 months' credit under Government facilities. Delivery of the plates is to be made in June and July of this year.

Sir Geoffrey Byass, Bt., chairman of Messrs. R. B. Byass & Company, Limited, Port Talbot, who is on a visit to Canada, stated on his arrival at Winnipeg that British tinplate manufacturers, for the first time for many years, are winning markets in Western Canada, due to the favourable rate of exchange. The company was booking orders at Winnipeg as well as at Toronto and other Eastern Canadian manufacturing centres.

Mr. Colville, Secretary to the Overseas Trade Department, stated in the House of Commons recently that as a result of negotiations with the Soviet trade representative it has been agreed that further credits for the sale to Russia of goods manufactured in this country may be granted with the export credits guarantee up to a total amount of £1,600,000. The terms will be fixed by the Advisory Committees in each case, but the maximum period of credit will be eighteen months and a substantial portion will be for twelve months.

We understand that Messrs. John Lysaght, Limited, have purchased the works of the Trent Iron Company, Limited, Scunthorpe, together with the goodwill and leases of iron ore, and in conjunction with Messrs. British Pigirons, Limited, have undertaken to continue the manufacture of all the special brands of pig-iron for which British Pigirons, Limited, are so well known. The latter hold all the existing stocks of iron at the Trent Company's works, and are in a position to execute all orders, pending a resumption of working.

Returns published by the Docks Department of the Great Western Railway Company for the ports of Cardiff, Swansea, Newport, Barry, Port Talbot and Penarth show that from January 1 last to May 8 exports of iron and steel rails, etc., from the six ports amounted to 89,585 tons, an increase of 19,136 tons compared with the corresponding period of last year. The exports of tinplates amounted to 196,170 tons, an increase of 53,167 tons. On the other hand, the imports of foreign iron and steel in the same period amounted to 27,884 tons, or a decrease of 8,930 tons, compared with the corresponding period of last year.

An early conference between representatives of the Algoma Steel Corporation, the Steel Company of Canada and the Dominion Steel & Coal Corporation, with the object of extending the markets for steel, was forecast by Sir Newton Moore, who was recently appointed president of the Dominion Steel & Coal Corporation, on his arrival at Sydney, N.S. The principal object of the conference, according to Sir Newton, will be to see that every possible ton of steel that is purchased in Canada is manufactured in the country. The conference would place the Canadian steel men in a position to discuss with British operators ways and means of securing wider Empire markets.

Obituary.

Mr. Frank Moore died at Edgbaston on Sunday, May 22, aged 78. He was at one time managing director of the Griffin Foundry, Limited, Birmingham, and subsequently became associated with businesses at Redditch.

The death is announced from Germany of Herr Heinrich Oeking, at the age of 82. Herr Oeking was the founder of the Oeking Steelworks, Düsseldorf, manufacturers of steel castings, and which before the war employed 800 workpeople.

Mr. Frederick Collis, chief accountant of the Darlington Rustless Steel & Iron Company, Limited, died at his home in Darlington on Friday, May 20. Before joining the Darlington Company Mr. Collis had been connected in technical and commercial capacities with various concerns, including Sir William Arrol & Company, Limited; Messrs. Dorman, Long & Company, Limited; and the Cleveland Bridge & Engineering Company, Limited.

We very sincerely regret to announce the death of Signor Commendatore Ing. Carlo Vanzetti, the most prominent of all Italian foundry owners. Signor Vanzetti, who died last Monday in Paris from a stroke, was amongst those early pioneers who took the inventions of Stassano, Gronwall, Bassanesi and others and practically developed their use to the great benefit of the Italian electric-steel industry. During the war his services to the British Government was recognised by the bestowal of the honour of the C.B.E. In 1926 he took part in the International Foundry Convention at Detroit, and his personality and devotion to the foundry industry were immediately appreciated by the various nationalities assembled there, to the extent that when the International Foundrymen's Technical Committee assembled shortly after they earmarked Mr. Vanzetti as a future President. This came about in 1930. One of the ambitions of his life was attained last September, when he became the virtual host to the highly successful foundry congress which he pioneered right through to a brilliantly successful conclusion. In his later years he has been helped in all his activities by his popular son, Dr. Guido Vanzetti, with whom and with his mother and sisters, the whole of the foundry industry of the world will be associated in their grief. Signor Vanzetti was a member of the Council of the Institute of British Foundrymen and held membership in the Iron and Steel Institute and the American Foundrymen's Association and was a Vice-President of the Association Technique de Fonderie.

Dr. Arthur Cooper, a pioneer of the steel industry on Tees-side, died on Tuesday, May 24, at the age of 83. Born in 1849, Dr. Cooper became apprenticed at the age of 16 at the Midland Railway Company's locomotive works at Derby, which he left to become an assistant to the engineer of Messrs. John Brown & Company's works at Sheffield. Three years later he was appointed to the management of the Bessemer steel department at these works, a position for which he had privately prepared himself by study. In the development of the basic Bessemer process he became closely associated with Sidney Gilchrist Thomas and Percy C. Gilchrist. In 1874 he left Messrs. John Brown & Company to take up a similar position at the works of Messrs. Brown, Bayley & Dixon. Soon after the preliminary trials of the basic steel process had been conducted at the works of Messrs. Bolckow, Vaughan & Company, at Middlesbrough, arrangements were made for carrying it out on a large scale in one of the Bessemer plants of Messrs. Brown, Bayley & Dixon's works. In May, 1880, Dr. Cooper read a Paper before the Iron and Steel Institute at its London meeting on "The Manufacture of Basic Steel and Iron from Phosphoric Pig," setting out the results of these experiences. A year later the North-Eastern Steelworks was formed, specially to work the process, by Messrs. Thomas, Gilchrist & Riley, who were associated with the late Sir Arthur Dorman, and Dr. Cooper was appointed general manager and later managing director of the company. When the works were merged with Messrs. Dorman, Long & Company, Dr. Cooper became a director of that firm. By the unanimous votes of the President and Council of the Iron and Steel Institute, Dr. Cooper was, in May, 1892, awarded the Bessemer Gold Medal for "important services in the development of the basic-Bessemer process." Two years later he was elected a member of the Council of that body, and was appointed President for the years 1912 and 1913. He also acted as President of the Institute in 1913-14. In 1913 the University of Leeds conferred upon him the degree of LL.D. The retirement of Dr. Cooper from the managing directorship of the North-Eastern Steelworks took place in September, 1919. Dr. Cooper was elected a member of the Tees Conservancy Commission in 1905, and continued until June of 1930, when he resigned.

Personal.

Mr. W. T. Bell, J.P., chairman and managing director of Messrs. Robey & Company, Limited, Lincoln, has been elected President of the Lincoln Chamber of Commerce.

Mr. W. E. W. Petter, eldest son of Sir Ernest W. Petter, has been appointed personal assistant to Mr. Bruce, the manager of the Aircraft Department of the Westland Works, Yeovil.

Mr. Laurence Ennis, director of Messrs. Dorman, Long & Company, Limited, who supervised the construction of the Sydney Harbour Bridge, has arrived back in England after attending the opening ceremony.

At a gathering of the employees of the Shaw Foundry Company, of Willenhall, last Wednesday evening, Mr. Ralph Halldron, eldest son of Mr. C. Halldron, a director of the firm, was presented by Mr. W. Soars, works manager, with a handsome clock to commemorate his forthcoming marriage.

General T. S. Hammond has been elected President of the American Foundrymen's Association. He is President of the Whiting Corporation and Vice-President of the National Engineering Company. He is Past-President of the National Founders' Association, the Foundry Equipment Manufacturers' Association and the Chicago branch of the National Metal Trades Association.

Mr. F. J. Lanahan has been elected Vice-President of the American Foundrymen's Association. He is President of the Fort Pitt Malleable Iron Company, and a director of the Warren Foundry and Pipe Corporation, besides being a member of the board of directors of the American Foundrymen's Association. He is a member of the American Iron and Steel Institute, and during the war he was chairman of the Malleable Iron Industry War Service Committee.

Five members of the American Foundrymen's Association were elected to the board of directors for a period of three years, at the annual meeting held in Detroit. They were Mr. E. H. Ballard, general foundry and patternshop superintendent of General Electric Company; Mr. H. Bornstein, director of Testing and Research Laboratories, Deere & Company; Mr. S. B. Cuthbert, superintendent of Foundries, Carnegie Steel Company; Mr. David Evans, President, Chicago Steel Foundry Company; and Mr. F. G. Smith, President, Osborn Manufacturing Company.

Company Reports.

Thos. Firth & John Brown, Limited.—Debit balance, £44,669; brought in, £75,983; credit balance carried forward, £31,313.

Park Gate Iron & Steel Company, Limited.—Profit, £18,601; brought in, £12,445; depreciation, £20,000; carried forward, £11,045.

Anderston Foundry Company, Limited.—Loss, £2,397; brought in, £1,307; from reserves, £7,732; dividend of 4 per cent.; carried forward, £2,142.

Stanton Ironworks Company, Limited.—Final dividend of 6 per cent., tax free, on the ordinary shares, making 10 per cent., free of tax, for the year.

Glenfield & Kennedy, Limited.—Net profit, £37,222; brought in, £65,581; final dividend of 6 per cent. on the ordinary shares, making 10 per cent. for the year; to staff pension fund, £6,000; carried forward, £62,396.

John I. Thornycroft & Company, Limited.—The interim payment on the 6 per cent. cumulative preference shares is being deferred until after the accounts for the year ending July 31 next have been completed.

Siemens Bros. & Company, Limited.—Profit, £310,908; brought in, £367,436; interest on and redemption of 4½ per cent. debenture stock, £67,439; dividend of 10 per cent. on the cumulative preference shares, £55,000; dividend of 7½ per cent. on the ordinary shares, £183,750; carried forward, £372,155.

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Raw Material Markets.

No improvement can be reported in the iron and steel markets, which have shown little improvement since Whitsun. Consumers in general are short of work and are only buying to satisfy their immediate needs. Continental material continues to be offered at cut prices, the duties proving ineffective. Little business is being done, however, by either home or foreign works. One satisfactory feature of the situation is the booking of a Russian order for 35,000 to 40,000 tons of plates, June-July delivery.

Pig-Iron.

MIDDLESBROUGH.—The demand for pig-iron remains very limited, both on home and export account. Some of the Cleveland foundries are reported to be using Midlands iron, and there are complaints against the makers' policy of charging more to local consumers than to the Scottish foundries. These complaints are pointed by the fact that the Scottish market has proved so unremunerative to the Middlesbrough producers during recent times. Overseas shipments show no sign of recovery. The formation of Dorman Long & Associates (China), Limited, is regarded as an event of potential importance.

The East Coast hematite market largely remains dull. Messrs. Gjers, Mills & Company, Limited, however, have decided to restart their Ayresome ironworks, in the evident anticipation of a revival in trade. It is feared that the large stocks of unsold iron still held at the various makers' works will continue to dominate the situation for some time. Some business has been done with South Wales consumers during the last few days. Mixed numbers are now quoted at 63s. per ton, with 6d. extra for No. 1 quality. The West Coast hematite market remains steady, mainly owing to the heavy consumption at the steelworks in Cumberland and North Lancashire. Bessemer mixed numbers are quoted at 66s. per ton at works.

LANCASHIRE.—It is disturbing to note that deliveries to foundries in this area are showing a slight falling-off, after having maintained a steady level for some months. More contracts are running out, and few are being renewed, hand-to-mouth buying being the rule. The continued cheapness of good scrap may be affecting the situation. For delivery to consumers in the Manchester district, Staffordshire and Derbyshire No. 3 are on offer at 67s. per ton, with North-East Coast foundry at about the same figure, Northamptonshire at 65s. 6d., Derbyshire forge at 62s. and West Coast hematite at around 81s. per ton. Indian brands are quoted at 75s. to 77s. per ton.

MIDLANDS.—Part of the output of pig-iron in this area is being stocked, owing to the slackness in the demand. Many sections of the light-castings trade are experiencing a quiet time, while the depression in the heavy engineering industries is unrelieved. A meeting of the pig-iron producers was held last week, but no change in prices was made. They are, therefore, 62s. 6d. per ton for Northants No. 3 and 66s. per ton for North Staffordshire, Derbyshire and Lincolnshire No. 3, including delivery to Birmingham and Black Country stations.

SCOTLAND.—Hardly any business is being done with consumers, and it will be months before the market can recover from its present lethargy. The output of the furnaces in operation is more than sufficient for the present demand. Prices are unchanged at 69s. 6d. per ton for No. 3 Scottish foundry iron, with the official minimum of 2s. 6d. per ton extra for No. 1. No. 3 Middlesbrough is at 56s. 6d. per ton at Grangemouth, but Northamptonshire foundry has been sold at below this price. Continental foundry iron is not competitive. Indian foundry arrives in diminishing quantities.

Coke.

The foundry-coke market remains very sluggish, business, as usual, being confined to hand-to-mouth requirements. Little buying will be seen until the position of the foundries has shown a considerable improvement. Best Durham coke is quoted at 37s. 6d. per ton upwards, with other grades at 2s. 6d. less. Welsh cupola coke ranges from 30s. to 45s. per ton, according to analysis, all delivered Birmingham.

Steel.

The steel trade has generally been inactive during the past week, principally owing to the continued depression in the shipbuilding and heavy engineering trades. More business is being done in the lighter sections. Some Russian and Japanese buying has provided a certain stimulus to the export market. There is only a quiet demand for tinplates and galvanised sheets. Few orders are being placed for semi-finished steel, although very low offers continue to be made by the Continental producers, who are meeting almost the whole of the 33⅓ per cent. duty. The bulk of the business going to the home makers is for higher-grade material.

Scrap.

A feature of the Cleveland scrap-iron and steel market has been a welcome increase in the demand for steel, but the sale of foundry iron shows no improvement. Quotations are 37s. 6d. for ordinary quality, up to 40s. for machinery quality and 34s. for light castings. A similar slackness prevails in many parts of the Midlands foundry industry, and buying is restricted. Heavy machinery cast-iron scrap, broken into cupola sizes, is offered at 47s. 6d. delivered, heavy pipe and plate scrap at 42s. 6d. delivered and clean light cast-iron scrap at 37s. 6d. delivered. In Scotland little scrap iron is being bought, but the following are current quotations:—Cast-iron scrap, machinery quality, 47s. 6d.; ordinary cast iron, 42s. 6d.; light metal, 35s. to 37s. 6d., delivered works. In South Wales, heavy cast iron in large pieces and furnace sizes is at 44s. to 45s., and good cast-iron machinery scrap at 45s. to 47s. 6d., but little business has been transacted.

Metals.

Copper.—The copper market has shown a further slump, Tuesday's quotation being £25 15s. to £25 16s. 3d. It is difficult to see how there can be a recovery until the present rate of consumption shows considerable improvement. Forecasts are being made of a world slump in copper, should the proposed tariff on copper imports be passed by the U.S. Government. The Bill being passed, the break-up of the Exporters' organisation would seem inevitable. It is proposed that a new cartel be formed by producers outside the States. In the meantime, Copper Exporters, Inc., are still officially quoting 6.25 cents per lb. c.i.f. Europe, but are only selling Customs metal, at the reduced quotation of 5.50 cents. Outside sellers, however, might accept down to 5.35 cents, up to September.

Closing quotations :—

Cash.—Thursday, £27 8s. 9d. to £27 10s.; Friday, £27 5s. to £27 7s. 6d.; Monday, £26 10s. to £26 11s. 3d.; Tuesday, £25 15s. to £25 16s. 3d.; Wednesday, £26 15s. to £26 17s. 6d.

Three Months. — Thursday, £27 7s. 6d. to £27 8s. 9d.; Friday, £27 3s. 9d. to £27 5s.; Monday, £26 8s. 9d. to £26 10s.; Tuesday, £25 15s. to £25 16s. 3d.; Wednesday, £26 15s. to £26 17s. 6d.

Tin.—On Monday the standard quotation fell to £117 5s., mainly as a consequence of the news of the German Government's resignation. The new output-curtailment scheme has yet to be finally accepted. The demand on the Continent has been very limited, while the position of American consumers, such as the tinplate manufacturers, denotes little improvement.

Official closing prices :—

Cash.—Thursday, £121 2s. 6d. to £121 7s. 6d.; Friday, £120 15s. to £121; Monday, £117 5s. to £117 10s.; Tuesday, £118 17s. 6d. to £119; Wednesday, £122 2s. 6d. to £122 5s.

Three Months. — Thursday, £123 5s. to £123 7s. 6d.; Friday, £123 2s. 6d. to £123 5s.; Monday, £119 10s. to £119 15s.; Tuesday, £121 to £121 5s.; Wednesday, £124 7s. 6d. to £124 10s.

Spelter.—The London market continues to show sluggishness, sellers being much more evident than buyers. After a slight recovery, due to reports of output-restriction schemes, the East St. Louis price has fallen back slightly to 2.875 cents.

Daily fluctuations :—

Ordinary.—Thursday, £12; Friday, £11 18s. 9d.; Monday, £11 16s. 3d.; Tuesday, £11 8s. 9d.; Wednesday, £12 1s. 3d.

Lead.—The inquiry has been disappointing during the week, both here and on the Continent, and the market has been weak. A conference of producers has just been held, to consider the question of restricting supplies, but little information is forthcoming. It is felt that nothing but a general revival in the consuming industries can improve the position of the base-metal markets, and such a revival does not seem very likely at the moment.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £9 11s. 3d.; Friday, £9 15s.; Monday, £9 15s.; Tuesday, £9 15s.; Wednesday, £10 5s.

Publications Received.

Powdered and Granulated Aluminium. Published by the British Aluminium Company, Limited, Adelaide House, King William Street, London, E.C.4.

We have admired in a number of foundries the smartness and cleanliness of stoves and other plant when finished in aluminium paint, but we confess that until the receipt of this beautifully presented brochure that such paint has a real thermal advantage, due to the fact that its highly-polished surface acts as a barrier to the passage of heat waves in either direction. This, we are told, holds good up to a temperature of 800 deg. C., after which the vehicle is burnt away and the aluminium-powder alloys disappears, necessitating renewal if it is desired to maintain these heat-reflecting properties. A pointer for those foundries which still possess wooden columns is given on page 10. Here it is claimed that aluminium paint provides a waterproof coating, besides helping to cut the illumination bill. This moisture-proof property is particularly recommended as being applicable to the wooden patterns used in foundry work.

The applications of aluminium paints are classified on pages 21 and 22 as being decorative, protective, light reflecting, heat reflecting, heat conserving and miscellaneous. In the section on calorising, it is suggested, that this process is suitable for treating annealing pots. Unfortunately, there are two types—one type is used for annealing wire, tinplates and other wrought-steel products, and the second for treating malleable castings. As the latter is a prolonged process, it would be interesting to have some "life" test data provided. Thermocouple sheaths is also suggested. The next application outlined is the well-known Thermit process, whilst, finally, the manufacture of aeroconcrete is described. This material is full of blow-holes in order to render it a worse conductor of heat and sound. Whoever compiles the publicity matter of the British Aluminium Company is a past-master in the art. The presentation of this brochure is brilliant, whilst the reading matter never fails to create and hold one's interest.

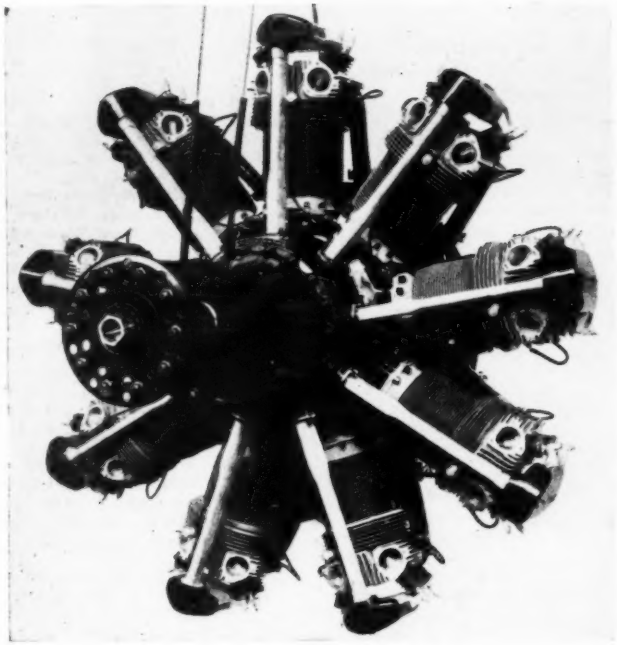
Stock Exchange Ten-Year Record of Prices and Dividends, compiled and published by Fredc. C. Mathieson & Sons, 16, Copthall Avenue, London, E.C.2. Price 21s. post free.

The great use of this 600-page compilation is that it helps the income taxpayer to place any dividends in its proper income-tax year, because deductions of tax are now at the ruling rate at the time of payment, without regard to the rate of tax during the period when the profits were made.

Refractories Bulletin No. 4, issued by John G. Stein & Company, Limited, Bonnybridge, Scotland.

This publication is especially useful, as it discloses the significance of chemical composition of firebricks. The diagram reproduced is, to our mind, so important that every metallurgist should have it clearly photographed in his mind as part of his mental equipment. The publishers, whilst recognising its value, have rightly drawn attention to the necessity for intelligent interpretation.

F.T.J. 2/6.32



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Standard cash	26 15 0
Three months	26 15 0
Electrolytic	31 10 0
Tough	28 15 0
Best selected	29 5 0
Sheets	59 0 0
India	41 0 0
Wire bars	33 7 6
Do., July	32 10 0
Do., Aug.	31 10 0
Ingot bars	33 7 6
H.C. wire rods	35 10 0
Off. av. cash, May	28 11 11½
Do., 3 mths., May	28 12 7¼
Do., Sttlmnt., May	28 11 9½
Do., Electro, May	33 6 8
Do., B.S., May	31 16 4⅔
Do., wire bars, May	33 16 8
Solid drawn tubes	9½d.
Brazed tubes	9½d.
Wire	6½d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	7½d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7¼d.
Rolled metal	6¾d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN.

	£ s. d.
Standard cash	122 2 6
Three months	124 7 6
English	123 15 0
Bars	122 10 0
Straits	123 2 6
Australian	120 17 6
Eastern	119 12 6
Banca (nom.)	128 17 6
Off. av. cash, May	122 7 6
Do., 3 mths., May	124 10 1½
Do., Sttlmt., May	122 8 1½

SPELTER.

	£ s. d.
Ordinary	12 1 3
Remelted	11 0 0
Hard	9 10 0
Electro 99.9	14 12 6
English	12 7 6
India	11 5 0
Zinc dust	21 0 0
Zinc ashes	2 0 0
Off. aver., May	12 11 1½
Aver. spot, May	12 8 7½

LEAD.

	£ s. d.
Soft foreign ppt.	10 5 0
Empire	10 10 0
English	12 5 0
Off. average, May	10 17 1
Average spot, May	10 13 5⅔

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	23 0 0
Do., V.M. ex-whf.	19 15 0
Rods	27 0 0
Boiler plates	—
Battery plates	—

ANTIMONY.

	£ s. d.
English	35 0 0 to 42 10 0
Chinese	24 0 0
Crude	16 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	13 5 0

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Ferro-silicon—	
25%	8 5 0
45/50%	12 15 0
75%	18 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	11d. lb.
Ferro-phosphorus, 20/25%	£21 0 0
Ferro-tungsten—	
80/85%	2/- lb.
Tungsten metal powder—	
98/99%	2/3½ lb.
Ferro-chrome—	
2/4% car.	£27 15 0
4/6% car.	£25 2 6
6/8% car.	£24 10 0
8/10% car.	£23 17 6
Ferro-chrome—	
Max. 2% car.	£37 10 0
Max. 1% car.	£47 2 6
Max. 0.70% car.	£49 12 6
70% carbon-free	1/1½ lb.
Nickel—80/99.5%	£225 to £230
"F" nickel shot	£207 0 0
Ferro-cobalt	8/3 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 0 0
Metallic manganese—	
94/96% carbon-free	1/5 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{7}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	1 19 0	to 2 1 0
Bundled steel and shrngs.	1 16 0	to 1 18 6
Mixed iron and steel	1 16 0	to 1 18 0
Heavy cast iron	2 4 0	to 2 5 0
Good machinery for foundries	2 5 0	to 2 7 6
Cleveland—		
Heavy steel	1 15 0	to 1 17 6
Steel turnings		1 12 6
Cast-iron borings		1 6 0
Heavy forge		2 12 6
W.I. piling scrap		2 5 0
Cast-iron scrap		1 17 6
Midlands—		
Light cast-iron scrap		1 17 6
Heavy wrought iron		2 10 0
Steel turnings, f.o.r.		0 19 6
Scotland—		
Heavy steel		1 17 6
Ordinary cast iron		2 2 6
Engineers' turnings		1 9 6
Cast-iron borings		1 10 0
Wrought-iron piling		2 2 6
Heavy machinery		2 7 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	24 0 0
Brass	16 0 0
Lead (less usual draft)	8 0 0
Tea lead	6 0 0
Zinc	6 10 0
New aluminium cuttings	72 0 0
Brazierv copper	21 0 0
Gunmetal	21 0 0
Hollow pewter	70 0 0
Shaped black pewter	50 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	63/6
Hematite M/Nos.	63/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	75/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/6
Clyde, No. 3	86/6
Monkland, No. 3	86/6
Summerlee, No. 3	86/6
Eglinton, No. 3	86/6
Gartsherrie, No. 3	86/6
Shotts, No. 3	86/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 12 6	to 9 15 0
Nut and bolt iron	7 15 0	to 8 10 0
Hoops	10 10 0	to 12 0 0
Marked bars (Staffs) f.o.t.		12 0 0
Gas strip	10 10 0	to 12 0 0
Bolts and nuts, ⅜ in. × 4 in.		12 0 0
Steel—		
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	8 7 6	to 9 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ¼ in. (Untested)	6 12 6	& up.
Flats—8 in. wide and over		8 12 6
,, under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0	to 8 10 0
Fishplates		12 0 0
Hoops (Staffs)		9 10 0
Black sheets, 24g.	8 0 0	to 8 10 0
Galv. cor. shts.	9 5 0	to 10 0 0
Galv. flat shts.	9 15 0	to 11 0 0
Galv. fencing wire, 8g. plain		12 7 6
Billets, soft	5 7 6	to 5 12 6
Billets, hard		6 12 6
Sheet bars	4 15 0	to 5 7 6
Tin bars		4 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	11½d.
Rods	10½d.
Tubes	16d.
Castings	12d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	14.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.89
Bessemer	16.89
Malleable	16.89
Grey forge	16.39
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	43.00
Billets	27.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.65
Sheets, black, No. 24	2.20
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
,, furnace	16/6 to 18/-
Durham and Northumberland—	
,, foundry	21/- to 25/-
,, furnace	13/- to 13/6
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes 20×14 per box	14/6 to 15/-
,, 28×20 ,,	29/- to 30/-
,, 20×10 ,,	—
,, 18¾×14 ,,	—
C.W. 20×14 ,,	—
,, 28×20 ,,	—
,, 20×10 ,,	—
,, 18¾×14 ,,	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, at'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
May	26 ..	27	8	9	dec.	1/3
,,	27 ..	27	5	0	,,	3/9
,,	30 ..	26	10	0	,,	15/–
,,	31 ..	25	15	0	,,	15/–
June	1 ..	26	15	0	inc.	20/–

Electrolytic Copper.

		£	s.	d.		
May	26 ..	31	15	0	No	change
,,	27 ..	31	10	0	dec.	5/–
,,	30 ..	31	10	0	No	change
,,	31 ..	31	0	0	dec.	10/–
June	1 ..	31	10	0	inc.	10/–

Standard Tin (cash).

		£	s.	d.		
May	26 ..	121	2	6	dec.	45/–
,,	27 ..	120	15	0	,,	7/6
,,	30 ..	117	5	0	,,	70/–
,,	31 ..	118	17	6	inc.	32/6
June	1 ..	122	2	6	,,	65/–

Tin (English ingots).

		£	s.	d.		
May	26 ..	122	10	0	dec.	45/–
,,	27 ..	122	0	0	,,	10/–
,,	30 ..	118	15	0	,,	65/–
,,	31 ..	120	10	0	inc.	35/–
June	1 ..	123	15	0	,,	65/–

Spelter (ordinary).

		£	s.	d.		
May	26 ..	12	0	0	dec.	2/6
,,	27 ..	11	18	9	,,	1/3
,,	30 ..	11	16	3	,,	2/6
,,	31 ..	11	8	9	,,	7/6
June	1 ..	12	1	3	inc.	12/6

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
May	26 ..	14	7	6	dec.	10/–
,,	27 ..	14	7	6	No	change
,,	30 ..	14	5	0	dec.	2/6
,,	31 ..	14	2	6	,,	2/6
June	1 ..	14	12	6	inc.	10/–

Zinc Sheets (English).

		£	s.	d.		
May	26 ..	23	0	0	No	change
,,	27 ..	23	0	0	,,	,,
,,	30 ..	23	0	0	,,	,,
,,	31 ..	23	0	0	,,	,,
June	1 ..	23	0	0	,,	,,

Lead (English).

		£	s.	d.		
May	26 ..	11	15	0	dec.	5/–
,,	27 ..	11	15	0	No	change
,,	30 ..	11	15	0	,,	,,
,,	31 ..	11	15	0	,,	,,
June	1 ..	12	5	0	inc.	10/–

AVERAGE PRICES OF GALVANISED CORRUGATED SHEETS (NORTH OF ENGLAND).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1902	12 0 0	11 10 0	11 10 0	11 10 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 14 2
1903	11 5 0	11 5 0	11 5 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 7 1
1904	11 5 0	11 5 0	11 5 0	11 5 0	10 15 0	10 15 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	10 5 0	10 15 0
1905	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	11 0 0	11 0 0	11 5 0	11 15 0	12 0 0	10 15 0
1906	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 12 6	12 12 6	12 15 0	12 15 0	12 15 0	13 5 0	12 12 11½
1907	13 5 0	13 5 0	13 15 0	13 15 0	13 15 0	13 15 0	13 17 6	13 17 6	13 17 6	13 2 6	13 2 6	13 2 6	13 10 10
1908	13 2 6	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 11 0½
1909	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 16 8
1910	11 15 0	12 5 0	12 5 0	11 15 0	11 10 0	11 10 0	11 12 6	11 12 6	11 12 6	11 12 6	11 10 0	11 10 0	11 13 4
1911	11 5 0	11 1 3	10 15 0	10 15 0	10 13 9	10 10 0	10 13 9	11 0 0	11 5 0	11 5 0	11 5 0	11 7 0	10 19 7½
1912	11 10 0	11 10 0	11 10 0	11 15 0	12 5 0	12 5 0	12 5 0	12 5 0	12 5 0	12 12 6	12 18 0	12 15 0	12 2 11½
1913	12 15 0	12 15 0	12 15 0	12 11 3	11 18 0	11 15 0	11 15 0	11 15 0	11 15 0	11 3 0	11 0 0	11 2 6	11 18 4
1914	11 7 0	11 7 6	11 7 6	11 5 7½	11 2 6	10 15 0	10 15 0	12 17 6	14 2 0	13 7 0	11 15 7	11 2 6	11 16 0
1915	11 10 8½	13 12 6	14 8 9	15 0 6	17 17 6	20 17 6	20 17 6	20 6 3	17 12 6	18 1 0	22 13 9	25 2 0	18 3 4½
1916	28 5 0	27 12 6	28 0 0	28 5 0	29 0 0	29 0 0	28 15 0	28 3 0	28 15 0	28 15 0	28 15 0	28 15 0	28 6 8½
1917	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 0 0	28 0 0	28 0 0	28 11 3
1918	28 5 0	28 15 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	28 13 4
1919	29 0 0	29 0 0	29 0 0	28 0 0	28 10 0	27 7 6	27 5 0	29 3 0	32 0 0	33 0 0	36 10 0	40 8 4	31 5 3½
1920	46 10 0	49 15 0	53 15 0	56 0 0	55 10 0	54 10 0	52 10 0	48 10 0	44 3 4	39 2 6	35 17 6	30 8 0	47 4 3
1921	28 10 0	25 17 6	24 5 0	23 3 4	22 0 0	22 0 0	23 10 0	21 12 6	20 0 0	18 15 0	18 3 9	17 2 0	22 1 7
1922	16 17 6	15 13 9	16 3 0	16 10 0	16 4 4½	15 15 6	15 16 3	16 16 0	16 8 9	16 6 3	17 1 0	17 7 6	16 7 5½
1923	18 3 1½	19 1 11½	19 8 0	19 10 0	19 7 0	19 1 3	18 0 0	18 13 1½	19 0 0	19 3 9	19 2 6	18 19 4½	18 19 2
1924	18 13 6	18 9 4½	18 5 0	17 15 11½	17 3 0	17 19 4½	18 7 6	18 8 1½	18 8 1½	17 19 6	17 11 3	17 10 0	18 0 10½
1925	17 8 6	17 1 6½	16 9 4½	16 12 0	16 9 8½	16 9 4½	16 0 6	16 1 10½	16 5 0	16 7 0	16 12 6	6 15 0	16 11 0½
1926	16 14 4½	16 5 7½	16 0 6	15 11 10½	15 11 3	16 0 0	16 16 0	16 18 9	16 14 0	16 18 9	17 10 0	6 19 0	16 10 0½
1927	16 3 1	15 7 6	15 3 3	15 3 1½	14 14 4½	14 11 6	14 1 10½	14 0 0	13 19 6	13 16 10½	13 13 1½	13 3 9	14 9 10
1928	13 0 0½	13 2 6	13 6 0	13 2 6	13 3 0	13 6 9	13 11 3	13 10 0	13 10 7½	13 12 6	13 11 6	13 10 0	13 8 8½
1929	13 11 0	13 13 1½	13 12 9½	13 10 11½	13 9 3	13 8 9	13 11 6	13 7 6	13 7 6	13 5 6	12 18 9	12 12 9½	13 7 5½
1930	12 5 0	11 15 0	11 19 6	11 18 7	11 18 0	11 17 6	11 17 6	11 17 6	11 16 3	11 12 6	11 8 9	11 5 0	11 15 11½
1931	11 4 0	11 0 0	11 0 0	11 0 0	10 13 9	9 18 9	9 13 0	9 5 3½	8 19 0½	9 16 0	9 8 9	9 4 0½	10 1 10½
1932	9 2 9	9 14 4½	9 16 0	9 13 9	—	—	—	—	—	—	—	—	—

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(A remittance should accompany instructions.)

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FOUNDRY Works Manager desires position; practical and technical training all branches iron and non-ferrous, thorough knowledge of stainless steel, expert on cupola, experienced engineering and patternshop; good organiser.—Box 166, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGICAL and Analytical Chemist, age 32 years, requires position; 15 years' practical and technical experience with leading firms manufacturing malleable and grey-iron castings for motor, agriculture, electrical trades, etc.; thorough knowledge of cheap, reliable mixtures for malleable, also experience general management.—Box 188, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY Manager desires engagement. Had first-class experience in modern foundry practice, practical, technical and metallurgical. Grey-iron castings up to 45 tons. Non-ferrous 15 tons. Expert repetition knowledge. Age 44. (176)

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PUBLICATION.

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THE Proprietor of the Patent No. 282366, for Improvements in the Manufacture of Steel, is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

THE Proprietor of the Patent No. 295315, for Manufacture of Iron and Steel Insensitive to Cold Shortness, Blue Shortness and Ageing, is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

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By Order of the Receiver.

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FOUNDRY PLANT,

Including THREE FLOOR GRINDERS, THREE POT FURNACES, SAND MIXER, 14 MOULDING MACHINES, SEVEN TILTING FURNACES, ONE TABOR PNEUMATIC TURN-OVER MACHINE, FOUR LATHES, ONE MILLING MACHINE, ONE DRILL, TWO GAS MIXERS, FOUR BAND SAWS, "SENTINEL" AIR-COMPRESSOR PLANT, TWO TRAVELLING CRANES, NINE ELECTRIC MOTORS, EIGHT PLATFORM AND OTHER SCALES, TWO "DEY" TIME-RECORDING CLOCKS, QUANTITY MOULDING BOXES, SAND MILL, SAW SHARPENER, QUANTITY FOUNDRY TOOLS, AND VALUABLE OFFICE FURNITURE.

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3-Ton "Evans"	... ...	£24
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PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

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